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Abstract

Taxation is one of the main components of a country's fiscal space. Its internal origin and the accountability it creates between rulers and populations make it a key element in financing public expenditure. Tax capacity differs between countries and depends on structural factors. A number of empirical studies attempted to determine countries' overall tax potential and tax effort (Lotz and Morss, 1967; Stotsky and WoldeMariam, 1997; Fenochietto and Pessino, 2013). However, the methodologies used tend to underestimate or overestimate countries' tax potential and thereby their tax effort. The purpose of this study is to better assess countries' non-resource tax potential and VAT's tax potential independently using a more appropriate method. It is in line with the study of Brun et al. (2014) and rests on a large sample of developing countries over the period 1980/2014. We first employ the previous models and discuss about their shortcomings, after we use the stochastic frontier model of Kumbhakar, Lien and Hardaker (2014). This model allows to disentangle the overall tax effort into a persistent tax effort due to policy economy decisions and a time-varying tax effort relating to tax administration efficiency. The results are more realistic. Low income countries have higher tax effort along the period even if their tax effort decline at the end of period on the opposite of resource depending countries. In fact, the latter characterized by lower tax effort compared to non-resource countries improved the efficiency of their system since 2010. The results also suggest that inefficiency in taxation depends more on policy decisions than on tax administration performance.

Keywords

Tax potential, Tax effort, Value-added tax, Non-resource revenues, Stochastic frontier model, Inefficiency.

JEL codes

C01, H2

Introduction

Resources allocation is a crucial function for a State. In fact, the public administration supplies some social infrastructures required for the welfare of population and contributing to the smooth running of economic activities in order to boost economic growth. Public expenditures concern education, health, roads, military expenditures, social security benefits, the supply of culture and sports infrastructures, operating expenditures, etc. These expenditures can be sorted according to their nature being more or less incompressible. One of the main resolutions adopted by the third international conference on financing for development is to mobilize resources for financing development post-2015 that requires to raise public resources such as tax revenues. " We commit to enhancing revenue administration through modernized, progressive tax systems, improved tax policy and more efficient tax collection. We will work to improve the fairness, transparency, efficiency and effectiveness of our tax systems, including by broadening the tax base and continuing efforts to integrate the informal sector into the formal economy in line with country circumstances" ¹. Nowadays, all countries face important challenges concerning security and climate change which adds to the structural financing requirement.

The mobilization of tidy resources is needed to finance at least a significant proportion of these expenditures. Recourse to various aspects of fiscal space must be optimised (marginal costs of various components of fiscal space must be equalised) (Chambas *et al.* , 2006).

Taxation is one of the main components of countries fiscal space. Its origin internal and the accountability it creates between rulers and populations make it a key element in mobilizing public resources. For some countries such as Timor-Leste, the overall tax revenues represent more than fifteen percent to Gross Domestic Product(GDP) ². For the highest grants receivers, taxation is a protection against the tall revenues failing if the relationship with the donors worsens or if that one is being through an adverse economic conditions. Mobilize a suitable level of non-resource tax revenues consists to have a component of public resources remaining stable over time which will be less sensitive to the failings of commodity prices for resource depending countries.

Being aware of revenues-generating power of taxation, governments choose a combination of taxes allowing them to have an adequate level of revenues. We can distinguish between corporate income tax, personal income tax, value-added tax (VAT), accises, etc. Benevolent governments try to make the least distortive combination while ensuring revenues. Value-added tax, to this extent is regarded as the least distortive tax which can generate a consequent amount of revenues. Its revenue-raising power justifies its choice by the majority of countries

1. Report of the third international conference on financing for development, Addis Ababa, 13-16 July 2015, Resolutions Adopted by the Conference, A/CONF.227/20, United Nations, New York 2015.

2. In 2010, Timor-Leste's overall tax revenues to GDP represented more than eighteen percent to GDP and until now it represents more than sixteen percent to GDP.

which start a tax transition process.

Tax revenues level differs between countries. It is well known that the level of development is correlated with countries' tax performance. Conforming to our analysis, over the period 2000/2014, emerging countries had an average non-resource tax ratio to GDP ratio of 15.83 compared to 10.31 for low income countries. But some low income countries such as Burundi³ raised more revenue ratio than a number of emerging countries. Governments tax according to their fiscal revenues forecasting or to achieve a goal set on by their regional institution of belonging⁴. However, the tax capacity is not the same for all countries and it depends on structural factors. Tax potential determined by taking into account structural factors must be the reference for governments revenue collection target as much as it regards countries characteristics to fix a level of revenues which can be generated. The amount of revenue collection will depend on tax effort brought by tax administrations under duress of tax policies elaborated by decisions takers. A number of empirical studies in cross section or panel data attempted to determine countries' tax potential or tax effort (Lotz and Morss (1967), Bahl (1971), Stotsky and WoldeMariam (1997), Fenochietto and Pessino (2013), Brun, Chambas and Combes (2006). However, just a limited number of studies as that of Brun *et al.* (2014) focused on non-resource tax potential. Moreover, methodologies used tend to underestimate or overestimate countries' tax potential and thereby their tax effort. The purpose of this study is to better assess countries' non-resource tax potential and VAT's tax potential independently using a more appropriate method. It is in line with the study of Brun *et al.* (2014) and rests on a large sample of developing countries over the period 1980/2014. We first employ the previous models and discuss their shortcomings next we use the stochastic frontier model of Kumbhakar, Lien and Hardaker (2014) which allows to disentangle the overall tax effort into a persistent tax effort due to policy economy decisions and a time-varying tax effort relating to tax administration efficiency. The results are more realistic compared to those obtained with the previous methodologies. Low income countries have higher tax effort along the period even if their tax effort declines at the end of period on the opposite of resource depending countries. In fact, the latter are characterized by lower tax effort compared to non-resource countries and improved importantly the efficiency of their system since 2010. The results also suggest that inefficiency in taxation depends more on policy decisions than on tax administration performance.

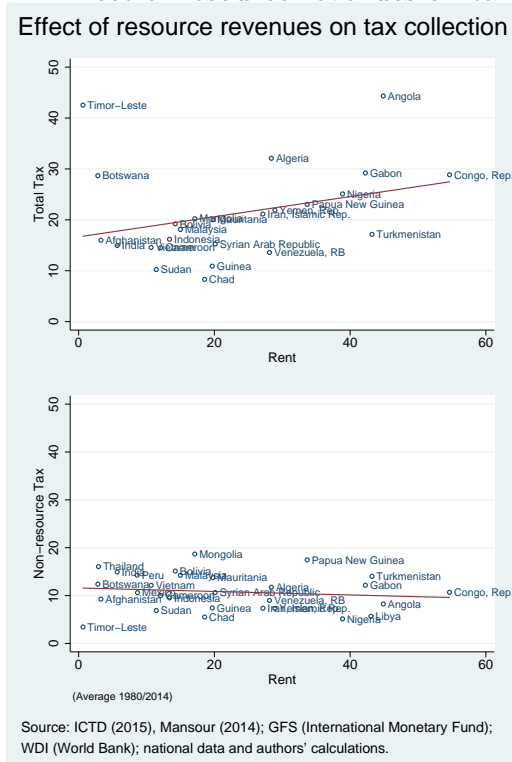
3. Burundi's non-resource tax ratio to GDP over the period 2000/2014 was 15.36 percent to GDP.

4. To coordinating the setting of tax rates and bases for the major taxes through regional directives, WAEMU Treaty mandates the convergence of the tax revenues-to-GDP ratio to at least 17 percent, and the convergence of tax revenues structures. (Mansour and Rota-Graziosi, 2013).

1 The impact of natural resources on countries' tax effort : stylized facts

Natural resources for a state constitute an important source of public resources. It generates an important rent usable to improve socio-economic conditions. In addition, resource depending countries apply taxes on their exports to recover a larger share of the rent. On the other hand, a vibrant mining sector dominated by a few large firms can generate large taxable surpluses (Gupta, 2007). By these channels, increasing revenues, the impact of natural resources on total revenues would be positive as obtained in the previous studies Bahl (1971), Chelliah *et al.* (1975), Tait *et al.* (1979). For Botlhole (2010) the nature of this relation depends on the quality of institutions. However, as Martinez Vazquez (2001), Lim (1988) said it, resource depending countries develop poor capacity to collect tax revenues. So, for these countries the link between natural resource revenues and non-resource tax revenues is in general negative. To test these assumptions empirically, we did two OLS linear regressions with our subsample of 31 resource depending countries. First, the overall tax revenues have been regressed on total natural resource rent and second it is the non-resource revenues that have been regressed on it. As shown by Figure 1, we found a positive impact for the overall tax revenues and a negative impact for non-resource revenues which confirm the idea that the resource depending countries provide less effort in term of revenue collection knowing that they rely on their natural endowment.

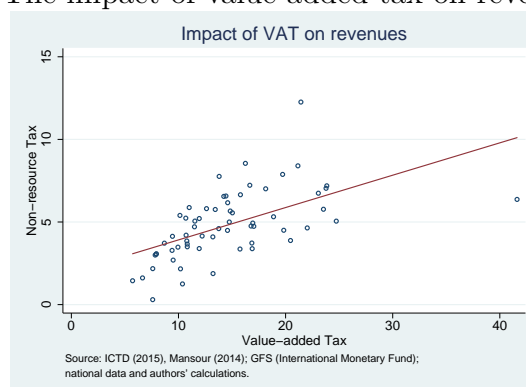
FIGURE 1 – Effect of resource revenues on tax collection



2 Toward a necessity to measure the efficiency of VAT systems by the empirical tool

The generalisation of Value-added tax around the world⁵ is due to the important revenues it creates and to its neutrality which is the main argument to justify the attention of the empirical research on this tax. The neutrality of VAT arises at the following levels : on

FIGURE 2 – The impact of value-added tax on revenue collection



the opposite of trade tax, VAT doesn't create distortions by encouraging local production to the disfavour of imported goods. Similar goods are taxed at the same rate regardless to their origin, so focusing on VAT is a positive sign by which a country proves to its current and future trade partners, its trade openness commitment. VAT does not affect the competitiveness of local producers insofar as exports are taxed to zero-rate thus, exporters can benefit from refund of the VAT charged on the production of exported goods. It doesn't increase the company's cost of production by the fact that they can deduct the VAT on their intermediate inputs of those they charge on the sell thereby, one can say that VAT is more favorable to the economic growth than the corporate income tax. Unlike some systems on sale tax VAT on a product, is neutral vis-a-vis the degree of integration of production i.e. the number of companies which contributed to its production⁶. The International Monetary Fund, knowing its ability to raise revenue, encourages countries to set on a VAT system in abandoning thereby their previous systems of sale tax. The reforms undertaken by tax authorities to run the VAT system or to improve its efficiency had a positive impact on all taxes collection. That explains its use, as a proxy of tax administration performance, in a number of empirical studies such as those of Aizenman and Jinjark (2005), Ruhashyankiko and Stern (2006), Sancak, Velloso and Xing (2010). The regional institutions assign a key role to VAT in the context to harmonize their tax policies. The Commission of WAEMU has designated it as the main instrument of tax transition of its member states. The European Union financed some studies such as Reckon (2009) and Netherlands Bureau for Economic Policy Analysis (2013) in the purpose to evaluate the efficiency of European countries' VAT systems. Moreover, other multilateral institutions published some reports on countries' VAT efficiency. Since

5. To this day, value-added tax has been introduced in more than 160 countries around the world.

6. Study of Brun and Diakité (2015) presented at the first African Tax Research Network annual congress.

2008, OECD, each two years, elaborates reports on its countries' VAT systems. The IMF in 2010 and 2011 did two major publications on Value-added tax efficiency. Brun and Chambas (2010) conducted a study on the efficiency of VAT of some African countries under the auspices of the African Development Bank, Trigueros *et al.* (2012) for Latina America countries.

However, these studies used some indicators known to measure VAT efficiency which have some limitations. The main criticism that can be addressed to the efficiency ratio elaborated by Ebrill *et al.* (2001) is its fluctuation according to the share of consumption in GDP. In fact, one can remark that for two countries having similar VAT revenues and the same consumption data, this ratio will be more important for the country for which consumption share in GDP is higher. Concerning c-efficiency developed by the same authors, the use of aggregate data on final consumption for its determining causes some problems insofar as among these data are included the VAT paid on purchases by final consumers. For this reason, the OECD since 2008 deducts the VAT collected on consumption in order to determine the VAT Revenue Ratio (VRR) in the purpose to measure the VAT efficiency of its member states more adequately. Nevertheless, the VRR itself is not without contempt on the fact that for the interpretation of the ratio, one supposes that some changes in the tax system will not affect the level or the composition of consumption. This reproach can be directed on all of the present indicators used to measure the VAT systems efficiency. Gemmel and Hasseldine (2012), concerning the VAT gaps indicators, point out the issue of reliability of the data employed to determine them and they advise to use these data with caution⁷.

So using empirical tools to measure VAT systems' effort will allow tax administrations to have an alternative indicator to appreciate their tax collection effort.

3 Literature review

A number of studies have been focused on measuring countries' tax potential and tax effort. One can sort them into three categories according to the methodology used.

Early studies such as Bastable (1903), Clark (1945) assessed countries' tax effort by appreciating the ratio tax revenues to income.

The study of Lotz and Morss (1967) attempted to provide a more robust indicator of countries' tax effort. They are regarded as the precursors of the use of the least squares estimators in the assessment of the tax potential. By working on a large sample of developing and developed countries, the authors used regression analysis and identified some determinants of governments' tax capacity allowing to determine tax effort (difference between actual and predicted tax revenues). As Hinrichs (1965), they found that income and

7. Brun and Diakité, (2015).

trade openness are a robust determinants of a country's tax capacity. The rank of countries according to their tax effort determined in previous studies changed with this methodology. Bahl (1971) developed tax effort's indices for forty-nine developing countries covering the three years' period 1966/1968. He regressed the ratio of tax revenues (excluding social security taxes) to Gross National Product on the structural factors used by his predecessors and added agriculture share in GNP and resource revenues which have proven to be significant. He found that countries with higher mining share in GNP have the lowest tax effort indices and the existence of a regional bias in the tax effort ranking. Chelliah et al. (1975) determined countries' tax efforts through the same variables as Bahl (1971) plus exports and they compared their evolution in reference to precedents IMF staff studies for forty-seven countries. They have not observed a significant change about countries tax effort ranking for the period 1969/1971. They remarked that countries with the highest tax ratio to GDP are those which have the highest tax efforts. Tait et al. (1979) have done the same study for the period 1972/1976. They also remarked no significant change in countries' tax effort during this period. Stotsky and WoldeMariam (1997) developed tax effort measures for forty-three sub-Saharan African countries during the period 1990/1995. Their strategy rested on a panel data fixed effects estimator. The findings of the authors are similar to those of Bahl (1971) and Chelliah et al. (1975). Martinez-Vazquez (2001), in studying Mexican tax system, determined tax efforts of 32 developing countries during the period 1990/1996. He obtained by a panel data regression that Mexico is among the bottom third countries in term of tax effort (ratio of actual to predicted tax revenues). Martinez-Vazquez (2007) remarked no significant improvement about Pakistan tax effort and he explained that by the large tax exemption and low tax compliance in Pakistan. Brun, Chambas and Combes (2006) assessed tax effort of a sample of eighty-five developing countries over the period 1980/2003 through a three years' averages by sorting them according to their geographic area. A random effects estimator was used and they regarded net exports of mineral and oil as a robust determinant of countries' tax potential. They found that tax effort of these developing countries decreased during the period 2000/2003 compared to 1990/1994. Particularly, Latina-American and Asian countries are distinguished by a constant negative tax effort during all of the period. Bird, Martinez-Vazquez and Torgler (2008), Botlhole (2010) showed that a country's tax effort may be influenced by its institutional factors such as corruption, voice and accountability. Botlhole (2010) employed a GMM estimator and a IV2SL estimator to assess forty-six sub-Saharan African countries' tax potential and tax effort. He found that African countries over the period 1990/2007 performed below their tax potential. Brun, Chambas and Mansour (2014) developed non-resource tax effort indices for a large sample of 124 developing countries over the period 1980/2012 by using a random effects estimator. For sub-Saharan African countries they found a decreasing in their tax effort until the early of 2000s during which, these countries improved their revenue mobilization due to the economic policy measures that they introduced from the early 1990s. Latina American and Asian countries are distinguished by a constant decreasing tax effort along the period which however seems to

arise for Latina American on the opposite of Asian countries.

In the late 90s, some researchers have been interested in the stochastic frontiers models which were originally based on the measurement of the productivity of firms. Jha et al. (1999) attempted to determine the tax efficiency of fifteen major Indian states by a stochastic frontier model. They found that the poorest states have the highest tax efforts. Alfirman (2003) by employing the model of Aigner, Lovell, and Schmidt (1977) assessed tax potential of Indonesian local governments and found that they did not achieve their tax potential. Barros (2005), employed a Cobb Douglas cost frontier model to measure the efficiency of tax offices in Portugal and found that it varies between offices and along the period. Pessino and Fenochietto (2010) developed a tax stochastic frontier analysis to determine tax potentials and tax efforts for a sample of ninety-six countries (developing and developed) over a sixteen years' period 1991/2006. They regarded tax effort as the ratio of actual to potential tax collection. They used three specifications i.e. the stochastic frontier models of Battese and Coelli (1992, 1995) estimated by the maximum likelihood method. They added to the traditional variables income inequality and public expenditures in education. They found that countries with higher levels of revenue (such as OECD countries) are near their tax capacity on the opposite of countries with lower level of revenue but there are some exceptions like Singapore, Hong Kong among the high income countries and Namibia, Kenya among the low income countries. They explained the inefficiencies in countries' tax collection by corruption and the percentage change of consumer price index. In a second publication in 2013, the authors employed the same strategy and a Mundlack random effects model to determine tax effort of an enlarged sample of 113 countries. Here, they did a distinction between 17 resource depending countries (where revenues from natural resources represented more than 30 percent of total tax revenues) for which they have just taken the non-resource tax revenues as dependant variable instead of the overall tax revenues taken for the 96 non-resource depending countries. The estimation of tax effort has been realized for each subsample independently. They found some large inefficiency parameters which are in an order of 2.8 for non-resource depending countries and 6.4 for resource depending countries. Overall, they found that the average tax effort of high income countries is higher compared to that of the other countries and it is higher for low income countries than for middle income countries. Cyan, Martinez Vazquez and Voluvic (2013) highlighted the economic logic beneath the concept of tax effort as defined in the previous studies and they try to link the tax effort to each country's financing requirement. Their study rested on a sample of ninety-four countries over the period 1970/2009. They compared the two approaches used to determine countries' tax effort (traditional regression approach by adding institutional factors and stochastic frontier approach in two steps) to a new approach consisting to determine countries tax effort conforming to their public expenditures⁸. They concluded by

8. The authors added to traditional variables, population variables as Bird, Martinez-Vazquez and Torgler (2008), education, inflation, Gini index, corruption as Pessino and Fenochietto (2010), grants, the lagged government debt, production of crude oil, a measure of tax system's complexity, a globalization index, age

the fact that the level of public expenditure of a country may serve as an additional informative measure to quantify its tax effort. The study of Langford and Ohlenburg (2016) quantified the overall tax capacity for 85 non-resource rich countries covering a 27 years' period by using the stochastic frontier model of Battese and Coelli (1995). They added to traditional variables mobilized to assess tax capacity the MIT's economic complexity index, ethnic tension and private sector credit. They found a wide variation in the estimated level of tax effort across the sample, on average the tax performance of the upper-middle and high income countries is higher than those of the low and lower-middle income countries.

About the value-added tax effort, to the best of our knowledge, there is no study which determines it independently by an empirical analysis. However, we must stress that there are some indicators communally used to appreciate countries' VAT performance as mentioned below such as the efficiency and the c-efficiency ratios elaborated by Ebrill et al. (2001), the VAT Revenue Ratio proposed by OECD (2008), the VAT gaps indicators developed by Reckon (2009), Keen (2013) for European Union countries, Trigueros et al. (2012) for Latina American countries, Brun and Diakité (2015) for African countries.

A number of empirical studies attempted to explain VAT performance or misperformance. First, by using variables describing the rules of the tax system such as the tax standard rate, threshold, base (Ebrill et al., 2001, Agha and Haughton, 1996). The number of year since the introduction of VAT is equally regarded as a relevant indicator of the tax performance by these authors. Structural factors have been mobilized i.e. the national income, imports, exports or trade openness, agriculture value-added, population variables (dependency rate, urban share or population density), literacy, income inequality and a large number of policy economy factors among them inflation (Ebeke, 2008), business concentration and gross capital formation in a specific sector or its size, consumption of particular item (alcohol, petroleum in Keen and Lockwoods, 2006), costs of tax administration (Agha and Haughton, 1996), output gap (IMF, 2015), lagged VAT efficiency indicator or total tax revenues (Bird and Martinez Vasquez, 2010). McCartney (2003 and 2006), Ruhashyankiko and Stern (2006), Christie and Holzner (2006) taken into account the impact of institutional factors like corruption, quality of legal or juridical system, a proxy of tax morale, the durability of policy system, a proxy for the wish for a fairer taxation on revenue mobilization. Overall, they found that the VAT performance is very different between countries and geographic areas. Developed countries and small islands have the best value-added tax performances on the opposite of sub-Saharan African countries. African countries, with comparable statutory VAT rates, have on average less VAT revenue per unit of aggregate private consumption, (Ruhashyankiko and Stern, 2006).

dependency ratio, a politicization fractionalization index.

4 Empirical analysis

4.1 Variables and data

4.1.1 Choice of variables

Estimating a tax potential equation requires to mobilize some structural factors that can define a level of revenue that a country can collect. The purpose is to predict a maximum level of revenue that the country can generate taking into account its specific characteristics. In this sense, it is different from the tax performance which is related to its ability to collect tax. Thus, tax performance can be influenced by policy decisions in adopting tax laws, tax management, the level of education of tax collectors, tax morale, the quality of institutions (bureaucracy quality, corruption). So, it is by improving its performance that a country can attain its tax potential or tax capacity. To remain consistent with this viewpoint, the assessment of tax potential and thereby tax effort in this study rests just on structural variables viz the **logarithm of GDP per capita**. An important national income supposes a wide tax base. In addition, demand for public goods increases with the level of development (Wagner's law), particularly because of social insurance requirements (Rodrik, 1999). The sign of its coefficient is expected to be positive. **Agriculture value-added**, subsistence agriculture, common in sub-Saharan African countries is informal. The majority of developing countries exempts the agriculture sector called "hard to tax". A higher non-agriculture share in GDP should thus produce a higher tax ratio (Bird and Martinez Vasquez, 2008). The sign of its coefficient is expected to be negative. **Openness**, as said by Lotz and Morss (1967), taxable capacity also increases with the size of the foreign trade sector for two reasons : first, it is administratively easier to tax trade inflows and outflows than domestic transactions. Second, the "degree of openness" in many countries, especially in early stages of development indicates the relative importance of cash crops and subsistence agriculture. Moreover, greater trade openness favours increased productivity and steadier growth (Frankel, 1999). **Resource revenues to GDP**, early studies such as Chelliah *et al.* , (1975) Tait *et al.* , (1979) found a positive impact of mining on taxation which can be explained by the taxation at export of oil and mining products often agriculture products. However, as Bahl (1971) found, countries with higher mining share to Gross National Product have the lowest tax effort indices. Moreover, the shocks engendered by non-renewable resources are likely to have a negative effect on tax revenues (Tanzi, 1981). The development of Dutch disease driven by the intensive use of revenues from mining can negatively affect other tradable sector tax bases, therefore leading to a further reduction in the domestic tax effort (Brun *et al.* , 2014). By using non-resource government revenues as a dependant variable we hope to find a negative impact of resource revenues to GDP as Bornhorst *et al.* (2009), Ossowski and Gonzales (2012), Thomas and Trevino (2013), Civilly and Gupta (2014) and Brun *et al.* (2014).

The same variables have been used to assess VAT's potential and effort knowing that they determine also VAT collection. This explains the use of these variables in the studies

concerning the value-added tax. GDP in Aizenman and Jinjark (2005), Ruhashyankiko and Stern (2006), Openness in Ebrill *et al.* (2001), Keen and Lockwoods (2006); Agriculture value-added in Bird and Martinez Vasquez (2010). For the resource revenue to GDP, we did not find a study that uses this variable but in our opinion, it is relevant given that resource depending countries tend to overlook their non-resource tax collection and have lower VAT rates such as Nigeria with a rate of 5% in 2011 or grant important VAT exemptions. For instance, the share of exempted goods by the government of Gabon was 52.98% in 2011⁹.

4.1.2 Data

Estimations are done with two unbalanced panels of 114 countries for the non-resource tax potential over the period 1980/2014 and 57 countries for the VAT potential over the period 1995/2014. There are 31 resource- depending countries (RDCs) in the first panel and 17 in the second. We defined as resource depending countries having resource tax greater or equal to 7% to GDP and/or countries having resource tax share to overall tax of 60% or more. According to the level of development, the first sample contains 30 Low Income Countries (LICs), 41 Lower Middle Income Countries (LMICs) and 43 Upper Middle Income Countries (UMICs)¹⁰. The second is respectively composed of 15 LICs, 19 LMICs and 23 UMICs. Data on the structural variables (GDP per Capita, Openness, Agriculture Share to GDP and Total natural resource rent) have been derived from the World Development Indicator database of the World Bank. Data on non-resource tax come from Mansour (2014) for Sub-Saharan-Africa countries and the rest coming from ICTD (2015), Government Finance Statistics(GFS) of the International Monetary Fund and national data; Data on Value-added tax revenues are from the IMF's GFS dataset. The average non-resource tax is 14.23% to GDP over the period, 15.32% for non-resource countries and 10.75% for resource depending countries. The average value-added tax per country ranges from 0.3% to 12.26% to GDP; The minimum value is for Iran (a resource depending country) which adopted its VAT regime in 2008 and the maximum value for Moldova.

4.2 Estimation strategies

Like some previous studies, we estimated countries' tax potential and effort using panel data regression. We first used a random effects estimator that we extended to a generalized two-stages least squares random-effects instrumental variables estimator (G2SLS-RE-IV) by instrumenting the GDP per capita which was lagged in the former estimations. Thereafter, for a better assessment of countries' tax potential, we used stochastic tax frontier models. As a first step, we employed a reference model applied in a large number of empirical researches (including that of Pessino and Fenochietto 2010 and 2013), that of Battese and Coelli (1992). Then, we discussed the shortcomings of this model and the others used to predict countries

9. Brun and Diakité, (2015).

10. Countries are classified according to the 2014's classification of the world's economies by the World Bank.

tax potential, we explained the repercussions of their use on tax potential assessment. Finally, we presented and used the stochastic frontier model of Kumbhakar, Lien and Hardaker (2014) in its random effects form that we believe more pertinent. To the best of our knowledge, our study is the first to use this model to predict tax potential and we think that the obtained results are more realistic. All tax effort indices are predicted following the Jondrow *et al.* (1982) technique.

4.2.1 Regression by the random effects estimator

Working with panel data allows to take into account each country unobserved heterogeneity that can be modelled deterministically (fixed-effects) or randomly (random effects). To predict tax potential, we preferred to include random effects because, as said by Brun *et al.* 2014, fixed effects estimator assimilate the unobserved heterogeneity to structural factors while random effects estimator assimilate only part of the unobserved heterogeneity to structural factors thus, the results are more coherent. We define tax effort as the ratio between actual tax revenue and tax potential.

The econometric models are as follow :

— **Equation of non-resource tax potential**

$$\log NRT_{it} = \beta'X_{it} + \epsilon_{it} \quad (1)$$

$$X_{it} = TNR_{it}; \log GDP_{it-1}; VAG_{it}; Open_{it}. \quad (2)$$

Where $\log NRT_{it}$ is the logarithm of non-resource tax revenues; TNR_{it} is the total natural resource rent; $\log GDP_{it-1}$ is the logarithm of lagged per capita GDP; VAG_{it} is the agriculture value-added to GDP; $Open_{it}$ corresponds to the sum of imports and exports in GDP percent and ϵ_{it} corresponds to the error term.

— **Equation of value-added tax**

$$\log VAT_{it} = \beta'X_{it} + \epsilon_{it} \quad (3)$$

$$X_{it} = TNR_{it}; \log GDP_{it-1}; VAG_{it}; Open_{it}. \quad (4)$$

Where $\log VAT_{it}$ is the logarithm of value-added tax revenues.

4.2.2 Regression by the g2sls random effects instrumental variables estimator

As mentioned above, the level of development is favourable to tax revenues collection. However, tax revenues enter in the accounts in calculating the national income. Previous studies (Brun Chambas and Combes 2006, Brun Chambas and Mansour 2014), as in our first regressions, to address this endogeneity problem, used the lagged GDP per capita to treat the inverse-causality between tax revenues and income per capita. Here, we generalized

our random effects estimator to a G2SLS random effects instrumental variables estimator.

Bothhole (2010) as Ali and Isse (2006) used land area as instrument of income and justified this choice by the fact that on average, large countries are often rich. But, we know that there are some LICs such as Niger, Mali having a large land area.

In this study, we used two instruments that we think more reliable : an indicator measuring the access to improved sanitation facilities which refers to the percentage of the population using improved sanitation facilities extracted from the World Bank development indicators dataset. The idea behind its use is that economic growth relies on productive human capital in good health. As said by Audibert *et al.* (2012), health status is an important predictor of economic development. In boosting economic growth, it has a positive effect on tax revenues collection by increasing the taxable income. The second instrument that we employed is the rainfall¹¹. In fact, agriculture is still predominant in developing countries, in 2009, more than 25 percent of GDP was derived from agriculture in many least developed countries according to the Food and Agriculture Organization of the United Nations' data. The agriculture sector viz subsistence-farm employs a large part of the workforce. Conforming to the same data, over 60 percent of the entire workforce, in sub-Saharan Africa are involved in agriculture. So, a poor rainfall affecting agricultural production tends to reduce the national income. Being aware that poor rainfall can at the same time reduce tax revenue by reducing the income of farmers, thereby their consumption of taxable items (knowing that their own production is generally exempted in developing countries and their activities are informal thus, they don't report income for tax purposes), we lagged this variable to lessen this effect. The Sargan-Hansen statistic obtained is of 0.079 with a p-value of 0.7787 for the equation of non-resource tax potential and respectively 1.156 and a p-value 0.2824 for the equation of value-added tax. We can therefore state that at least one of our instrumental variables is exogenous.

4.2.3 Regression by the stochastic frontier models

The Stochastic frontier estimation methodology was first proposed by Aigner, Lovell & Schmidt (1977) and Meeusen & van den Broeck (1977). It was initially used for modelling production and technical efficiency of firms. A production function predicts a maximum level of outputs that a firm can product given a level of inputs. As said by Kumbhakar *et al.* (2015), all production processes represent a transformation of inputs (for example, labor, capital, and raw material) into outputs (which can be either in physical units or services). A production function simply describes this transformation relationship as a "black box"

11. This variable was employed to instrument the economic development (income per capita) by Brückner (2011) in a study consisting to measure the impact of economic growth and the size of the agricultural sector on the urbanization rate and by Guerineau and Sawadogo (2015) in analyzing the determinants of life insurance development. It has been derived from the National Aeronautics and Space Administration (NASA) Global Precipitation Climatology Project (GPCP) dataset.

which converts inputs into outputs. The difference between the stochastic production and the other used in empirical research concerns the error term which in the former is divided in two or more parts. From an econometric point of view, the estimation of frontiers is interesting because the concept of maximality puts a bound on the dependent variable (or, in some models, at least on some component of the dependent variable) (Førsen, Lovell and Schmidt, 1980). Stochastic frontier models are estimated by the maximum likelihood method to panel data or by the corrected ordinary least squares to cross section data.

The first models proposed are time invariant technical inefficiency models developed by Pitt and Lee (1981), Schmidt and Sickles (1984) Battese and Coelli (1988).

The general specification of these models is as follow :

$$\log Y_{it} = \alpha + f(\log X_{it}; \beta) + \epsilon_{it} \quad (5)$$

$$\epsilon_{it} = v_{it} - u_i \quad (6)$$

$\log Y_{it}$ is the logarithm of revenue for firm i at time t (about taxation, tax revenues for country i in year t); $\log X_{it}$ is the vector of inputs in logarithm (vector of structural factors which determine countries' tax capacity); β is the associated vector of parameters to be estimated; $v_{it}(t = 1...T)$ corresponds to the two-sided random statistical noise; $u_i \geq 0, (i = 1...N)$ is the one-sided inefficiency term, it is time-invariant and specific to each country and distributed independently of v_{it} . The function is of transcendental logarithmic type.

The maximum likelihood uses the following assumptions in estimating the parameters :

$$u_i \sim N(0, \sigma^2) \quad (7)$$

$$v_{it} \sim N(0, \sigma_v^2) \quad (8)$$

Tax potential in these models is the ratio of tax performance (actual revenues) to technical efficiency predicted thereby tax effort corresponds to the technical efficiency.

1. Regressions by the stochastic frontier model of Battese and Coelli (1992)

The time decay model of Battese and Coelli (1992) as those of Cornwell, Schmidt and Sickles (1990), Kumbhakar (1990), Lee-Schmidt (1993), is from the second generation of the stochastic frontier models. These models question the assumption done by the previous about the invariability of technical inefficiency. In fact, this means that countries can't improve their tax performance over time. Thus, a tax reform or changes in tax management would not have any practical effect on tax performance, which is unlikely. The time-varying model technical efficiency model of Battese and Coelli (1992) corrects this deficiency by allowing efficiency to change over time and expo-

nentially. It is a random effects type, so its use is consistent with our first regressions. The model takes the following form :

$$Y_{it} = f(X_{it}; \beta) \exp(v_{it} - u_{it}) \quad (9)$$

$$u_{it} = \eta_{it} u_i = \exp[-\eta(t - T)] u_i \quad (10)$$

$$t \in g(i); i = 1 \dots N \quad (11)$$

$$v_{it} \sim N(0, \sigma_v^2) \quad (12)$$

$$u_i \sim N(\mu, \sigma^2) \quad (13)$$

When countries improve or know a decrease in their tax performance respectively ($\eta \geq 0, \eta \leq 0$) if it remains constant, $\eta = 0$. The parameters μ and σ^2 define the statistical properties of the country effects associated to the last time period (T) for which observations are available¹². The efficiency term can be either half-normal distributed or truncated normal distributed. The half normal distribution assumes that the mode in the distribution is zero (Pascoe *et al.* , 2003). The assumption underlying is that the proportion of tax administrations achieving their potential is the greatest. However, the truncated distribution which is more general, assumes that this proportion can vary. Here the mode in the distribution is positive.

2. Toward a better assessment of the tax potential : regressions by the stochastic frontier model of Kumbhakar, Lien and Hardaker (2014) in its random effects form

The panel data model of Battese and Coelli (1992) is somewhat restrictive because it only allows inefficiency to change over time and exponentially. Furthermore, this model mix firm effects to inefficiency (Kumbhakar *et al.* 2014). Greene (2005), Wang and Ho (2010) proposed some models which allow to separate individual heterogeneity. However, none of the above models distinguish between persistent and time-varying efficiency¹³. Identifying the magnitude of persistent inefficiency is important, especially in short panels, because it reflects the effects of inputs like management (Mundlak, 1961) as well as other unobserved inputs which vary across firms but not over time¹⁴. The advantage of the stochastic frontier model of Kumbhakar, Lien and Hardaker (2014) is that in addition to consider countries heterogeneity apart from their technical efficiency, it does a distinction between their time-varying and persistent inefficiency. In other words, it divides the error term into four components : random countries effects which capture time invariant unobserved variables (omitted

12. Battese and Coelli (1995) developed a model in which countries' technical inefficiency depends on exogenous factors. To comply with our definition of tax potential, we decided to not use this model by take into account the inefficiencies variables which for us impact rather countries' tax performance than their tax potential

13. The model of Kumbhakar and Hesmatti (1995) done this distinction but not take into account the country effects.

14. Kumbhakar, Wang and Horncastle (2015).

structural factors); countries' heterogeneity knowing that they differ in culture, tax morale; persistent technical efficiency relating to tax laws, the form of organisation of inland revenue services (for instance dividing it into the division of major enterprises, the small and medium-sized enterprises department and municipalities tax administrations) and remains constant unless there is a tax reform or a changes in organisation that affect the management style; and time-varying efficiency such as the experience of tax officers, their performance. Thus, we can assess at the same time the tax effort due to the policy decisions and this due to tax administration performance and the overall tax effort which is the product of the first two. This has an important policy involvement by the fact that if the persistent inefficiency component is large it means that the increasing of tax effort requires a change in tax laws or a change in organisation and an important residual inefficiency is a wake-up call for tax administration to improve its performance and be more vigilant about tax evasion. This may lead to deeper issues like administrative corruption. Furthermore, by this methodology we can assess tax effort of countries according to the tax performance of the top 10 percentile (most efficient countries) and median that will allow us to mitigate the existence of outliers in our sample that conduct in high estimates of tax potential.

The model is of the form :

$$Y_{it} = \alpha + f(X_{it}; \beta) + \theta_i + v_{it} - \eta_i - \lambda_{it} \quad (14)$$

θ_i is the random country effects; v_{it} is the country's latent heterogeneity; η_i is the persistent inefficiency; λ_{it} corresponds to the short run varying inefficiency.

The model is estimated in three steps. It can be rewritten as :

$$Y_{it} = \alpha^* f(X_{it}; \beta) + \omega_i + \epsilon_{it} \quad (15)$$

Where :

$$\alpha^* = \alpha - E(\eta_i) - E(\lambda_{it}); \quad (16)$$

$$\omega_i = \theta_i - \eta_i + E(\eta_i); \quad (17)$$

$$\epsilon_{it} = v_{it} - \lambda_{it} + E(\lambda_{it}). \quad (18)$$

ω_i and ϵ_{it} have constant variance and zero mean.

Step 1 : (β) is estimated by the standard random effects estimator that corresponds to our first regression in this study. Thereby we obtained the predicted values of ϵ_{it} ($\hat{\epsilon}_{it}$) and ω_i ($\hat{\omega}_i$).

Then, in **Step 2** we make the following assumptions : there is no difference between

ϵ_{it} and $(\hat{\epsilon}_{it})$. $\lambda_{it} \sim N^+(0, \sigma^2)$ and $v_{it} \sim N(0, \sigma_v^2)$ so $E(\lambda_{it}) = \sqrt{\frac{2}{\pi\sigma}}$. We estimate the equality (18) by stochastic frontier technique, thus we obtain $\hat{\lambda}_{it}$. Time-varying Tax effort = $-\lambda_{it}$.

In [Step 3](#), η_i is estimated following a similar procedure as in [Step 2](#), by assuming $\eta_i \sim N^+(0, \sigma_\eta^2)$. $E(\eta_i) = \sqrt{\frac{2}{\pi\sigma_\eta}}$ and $\theta_i \sim N(0, \sigma_\theta^2)$ so here we estimate the equality (17) and obtain $(\hat{\eta}_i)$.

Persistent Tax Effort = $\exp(-\eta_i)$.

$\hat{\eta}_i$ and $\hat{\lambda}_{it}$ are the Jondrow *et al.* (1982) estimators of η_i and λ_{it} .

Overall tax effort = Persistent Tax Effort*Time-varying Tax effort

5 Empirical findings

5.1 Results of estimates through the random effects and the g2sls-random effects instrumental variables models

With the random effects estimator, for the non-resource tax equation, all of the coefficients are significant and their signs are consistent with those presumed (as shown in the Table 1, below) which means that economic growth and openness increase the potential revenues to be collected by a nation. On the opposite, a large natural resource revenues and share of agriculture value-added are unfavourable to the non-resource tax collection. The significance of coefficients and their signs are the same in the G2SLS random effects instrumental variables estimation. As said above, the p-value associated to the Sargan statistic is sufficiently high to confirm the assumption that at least one of our instruments is valid. Concerning the value-added tax equation, for the two first estimations, the coefficients are also statistically significant except for that of agriculture value-added in the G2SLS- random effects estimation. The statistic of Sargan-Hansen is also significant even if it is higher than that of the non-resource tax equation.

The non-resource tax potentials predicted with the random effects estimator and the G2SLS-RE-IV estimator are available in Table 10¹⁵. The potential predicted with the two models are similar even if those predicted with the G2SLS-RE-IV estimator are lower. With the random effects model, they range from 27.58 in GDP percent for Seychelles (a non-resource country) to 14.01 for Bolivia (a resource depending country), in 2012, with a respectively tax efforts of 102.97 and 152.30. This means that Bolivia in 2012 collected more than 150 percent of its tax potential. Results for the other countries tend also to affirm that all of the countries in the sample are near or exceed their potential¹⁶. The tax effort

15. In order to provide a readable angle in the Table 10, we present the results for the tax potential and tax effort for the last year period for that information are available. Results for the other estimations are available in the tables below that one and are presented in the same way.

16. Unless for Mexico which collected less than 50 percent of its tax potential in 2011.

TABLE 1 – Random effects and G2SLS-RE-IV estimations' results

	lnonrestax	lnonrestax	lvat	lvat
VARIABLES	(RE)	(G2SLS-RE-IV)	(RE)	(G2SLS-RE-IV)
lgdpcap_1	0.132*** (0.0200)		0.382*** (0.0735)	
Renty	-0.00407*** (0.000805)	-0.00452*** (0.000832)	-0.00572** (0.00241)	-0.00630*** (0.00240)
Openness	0.00148*** (0.000262)	0.00116*** (0.000277)	0.00225** (0.000993)	0.00221** (0.000977)
Vagry	-0.0102*** (0.000946)	-0.00471*** (0.00121)	-0.00877** (0.00442)	-0.00657 (0.00509)
Lgdpcap		0.334*** (0.0357)		0.410*** (0.102)
Constant	1.781*** (0.156)	0.252 (0.267)	-1.297** (0.590)	-1.555* (0.806)
Observations	2,356	1,828	481	471
Number of id	101	100	57	57
R-sq within	0.293	0.237	0.0559	0.0548
R-sq between	0.249	0.196	0.0796	0.0650
R-sq overall	0.166	0.178	0.203	0.249
sigma_u	0.350	0.311	0.614	0.540
sigma_e	0.198	0.165	0.192	0.183
Rho	0.758	0.780	0.911	0.897
Sargan-Hansen Statistic		0.079 P-value = 0.7787	Sargan-Hansen Statistic	1.156 P-value = 0.2824

Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

levels are similar for the value-added tax. In fact, the predicted tax effort accounted for up to 283.71 for Moldova in 2011. If the random effects estimator is preferable to that of fixed effects to predict tax potential, compared to stochastic frontier models, it doesn't give the maximum level of revenue (the frontier) that can be collected, thereby, the tax effort predicted is overestimated. We must stress that this effect is amplified if the sample is constituted by countries having similar characteristics, the reference standard being provided by the average behaviour of the whole panel.

5.2 Results of estimates by the half normal and the truncated normal stochastic frontier models of Battese and Coelli (1992)

By a maximum likelihood estimation of the parameters, we obtained a statistical significance for all of the coefficients except for the agriculture value-added in the two value-added tax equations. The coefficients of yearT in the gamma function are significant which implies that (for the first specification) countries' non-resource tax inefficiency decreased along the period this means that they knew an increasing in the effort about 0.43% per year. In the Value-added tax potential truncated normal equation, Mu (The pretruncation mean of the distribution of the inefficiency) is not significant and the log likelihoods are quite similar in the two estimations which means that truncated normal model is not preferred to the half normal model.

The predicted tax potentials are very large that is therefore not surprising because this

model allows efficiency to change exponentially. Thereby, the tax potential of a low income country such as Burkina Faso is 25.31 (half normal model) or more 30.50 in GDP percent (truncated normal model) in 2010. These estimations are excessive, given that a developed country like France, moreover known for the efficiency of its tax administration collected 25.46 as the ratio of non-resource tax to GDP the same year. If the VAT potentials predicted are better, however same case occurs with a number of countries like Botswana for which the VAT potentials are respectively with the two models 26.62 and 25.80 to GDP.¹⁷

TABLE 2 – Results of estimations by the time decay model of Battese and Coelli (1992)

Variables	lnonrestax		lvat	
	Truncated Normal	Half-Normal	Truncated Normal	Half-Normal
frontier				
lgdpcap	0.0906*** (4.26)	0.0638** (3.27)	0.384*** (4.48)	0.376*** (4.42)
Renty	-0.00500*** (-6.19)	-0.00518*** (-6.36)	-0.00895*** (-4.02)	-0.00898*** (-4.04)
openness	0.00120*** (4.56)	0.00158*** (6.82)	0.00207* (2.22)	0.00219* (2.52)
Vagry	-0.00875*** (-9.15)	-0.00953*** (-9.98)	-0.00756 (-1.94)	-0.00750 (-1.93)
_cons	2.999*** (19.12)	2.981*** (20.31)	-0.253 (-0.42)	-0.231 (-0.38)
Mu				
_cons	0.858*** (8.73)		0.319 (0.54)	
Gamma				
yearT	-0.00435*** (-5.68)	-0.00545*** (-6.42)	-0.0116*** (-4.28)	-0.0119*** (-4.38)
usigmas				
_cons	-2.045*** (-12.28)	-0.564*** (-3.42)	0.0516 (0.10)	0.267 (1.04)
vsigmas				
_cons	-3.252*** (-110.20)	-3.245*** (-109.68)	-3.338*** (-47.12)	-3.335*** (-47.10)
N	2403	2403	481	481
Log likelihood	276.95818	258.00024	-7.5180648	-7.617672

t statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5.3 Results of estimates by the model of Kumbhakar, Lien and Hardaker (2014)

As mentioned above, the tax effort from this model is predicted by following a procedure in three steps and the first corresponds to the standard random effects estimation. Having presented the results of this estimation in Table 1 here we will comment directly the results of the Step 2.

17. The pretruncation means of the distribution of the inefficiency terms are some constants. usigmas and vsigmas are the variance parameters in the table below.

Estimates of the error components from the random effects models by the stochastic frontier method, allow us to obtain the time-varying tax effort. By dividing countries according to the level of development, we remark that on average, over the last five years (2010/2014), the time-varying tax effort of the low income countries (92.67) was higher than that of the lower middle income countries (87.95) and that of the upper middle income countries (87.87). For the VAT time-varying effort, there is no significant difference between the average tax effort of the UMICs (88.85) and that of the LICs (88.59). This of the LMICs is 86.76.

TABLE 3 – Estimation of the error component to predict the time-varying tax effort

Variables	lnonrestax Error component ($\widehat{\varepsilon}_{it}$)	lvat Error component ($\widehat{\varepsilon}_{it}$)
frontier _cons	0.151*** (16.31)	0.159*** (11.56)
usigmas _cons	-3.308*** (-28.34)	-3.176*** (-19.79)
vsigmas _cons	-3.733*** (-59.21)	-4.019*** (-33.79)
<i>N</i>	2356	481
<i>Log likelihood</i>	544.84497	142.20391

t statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

By estimating the random effects components also with the stochastic tax frontier method, we obtained the persistent tax efforts. They are significantly lower than the time-varying tax efforts especially those of the value-added tax. These results are consistent with the findings of the study of Brun and Diakité (2015) on sub-Saharan African countries, according to which for these countries, tax gaps depend more on policy decisions (laws, organization) than tax officers' performance. The figures on the average time-varying and the persistent tax efforts are in the Table 5 below.

TABLE 4 – Estimation of the random effects component to predict the persistent tax effort

Variables	lnonrestax Random effects component ($\widehat{\omega}_i$)	lvat Random effects component ($\widehat{\omega}_i$)
frontier _cons	0.329*** (19.40)	0.690*** (10.18)
usigmas _cons	-1.889*** (-18.01)	-0.325 (-1.74)
vsigmas _cons	-2.802*** (-33.20)	-2.053*** (-7.26)
<i>N</i>	2356	481
<i>Log likelihood</i>	-781.76168	-443.59226

t statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The overall non-resource tax effort and VAT effort has been determined through the

TABLE 5 – Average persistent and time-varying non-resource tax efforts by income group

Countries	Time-varying tax effort	Persistent tax effort
	(Average 1980/2014)	
LICs	76,01	71,48
LMICs	77,80	53,30
UMICs	72,16	44,26

Source: ICTD (2015); Mansour (2014); GFS (International Monetary Fund); WDI (World Bank); national data and authors' calculations.

product of its two components (persistent and time-varying tax efforts)¹⁸. The average non-resource tax effort of the LICs was the highest in the early 1980s, it has declining subsequently and has re-reached its former level in the 2000s characterized by important changes in tax management to run or improve VAT systems. Moreover, one can observe that even if the average non-resource tax effort of these countries failed at the end of the period that of VAT continues to rise. the LMICs and the UMICs are also characterized by important tax efforts which have not however regular trends. If the tax efforts of the non-resource countries (NRCs) are higher than those of the RDCs, the latter demonstrated a willingness to improve the efficiency of their tax system at the end of the period, even if there is much work to be done namely about the value-added tax. As shown by the non-resource tax and VAT efforts' maps (Figure 7 and Figure 8), we don't observe a regional homogeneity in term of tax efforts except for the value-added tax effort in WAEMU area which shows an efficiency particularly high.

The tax potentials obtained by this model which allows to disentangle countries' heterogeneity and their tax effort seem much more consistent whether it is for the non-resource tax or VAT. The differences in efficiency have not affected tax effort indices and thereby countries' tax potentials, as shown by the Figure 3 and the Figure 4 below, there is not an important difference between these tax potentials and those predicted by the median which allows to mitigate the existence of outliers in the sample.

18. Figure 5 and Figure 6 in the appendix show the evolution of the three categories of tax efforts over the period and per income group for the non-resource tax and value-added tax.

TABLE 6 – Non-resource tax efforts along the period by income group

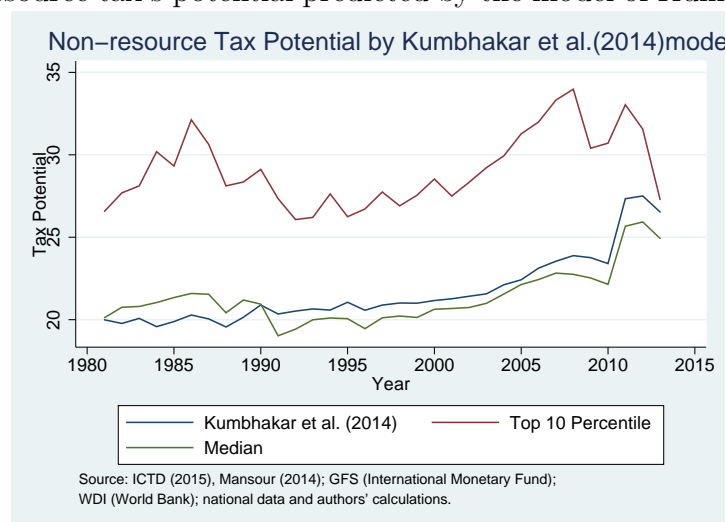
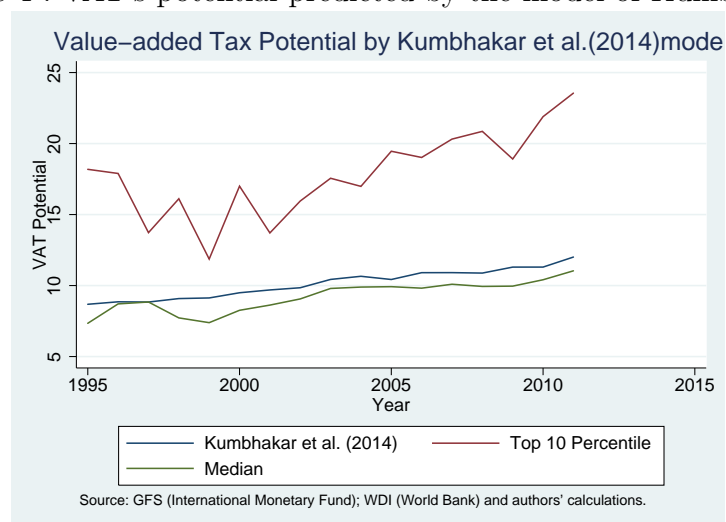
	LICs	LMICs	UMICs	RDCs	NRCs
(1980-1984)	67,28	65,95	62,11	52,56	68,14
(1985-1989)	64,41	67,61	63,48	56,76	67,65
(1990-1994)	63,85	68,02	63,25	57,89	67,61
(1995-1999)	66,23	68,05	61,89	58,62	67,62
(2000-2004)	66,34	66,35	61,24	56,30	67,34
(2005-2009)	67,73	67,72	61,39	55,98	68,50
(2010-2014)	65,12	67,44	65,32	63,45	67,02

Source: ICTD (2015); Mansour (2014); GFS (International Monetary Fund); WDI (World Bank); national data and authors' calculations.

TABLE 7 – Value-added tax efforts along the period by income group

	LICs	LMICs	UMICs	RDC	NRC
(1995-1999)	55,28	34,81	34,84	37,16	45,87
(2000-2004)	61,07	49,77	38,31	43,09	49,56
(2005-2009)	63,92	51,70	39,80	36,78	52,77
(2010-2014)	67,61	54,59	39,72	40,37	54,12

Source: ICTD (2015); Mansour (2014); GFS (International Monetary Fund); WDI (World Bank); national data and authors' calculations.

FIGURE 3 – Non-resource tax's potential predicted by the model of Kumbhakar *et al.* (2014)FIGURE 4 – Figure 4 : VAT's potential predicted by the model of Kumbhakar *et al.* (2014)

Conclusion and recommendations

This study intended to provide more consistent non-resource tax and VAT efforts and potentials for a large sample of developing countries. This required to go through the previous methodologies, discuss their shortcomings to go toward a more relevant model with more realistic and robust predictions. The stochastic frontier model of Kumbhakar, Lien and Hardaker (2014) besides the benefits it provides in term of giving a maximal tax potential that a country can reach by improving its tax effort allows to disentangle the effort between a persistent tax effort due to the policy decisions and a time-varying tax effort relating to tax officer's performance. Hence, the sources of inefficiency being known, it is easier for countries to make appropriate decisions to improve their tax performance.

Our findings prove that a large number of developing countries make efforts to collect taxes even if there are possible improvements namely regarding value-added tax collection. The LICs characterised by important tax efforts along the period, showed a decline in their performance at the end of the period on the opposite of the resource-depending countries (which are generally emerging countries) that enhanced efficiency of their tax system. It proves that these countries are willing to increase a more stable component of their fiscal space which goes to their advantage when looking at the fiscal problems faced by most of them to this day, what drives some countries to call on additional foreign fund to finance their economies.

Furthermore, we must stress that the top performing countries, in terms of tax effort, should instead stabilize their tax revenues. Their actions can be oriented toward a reduction of the distortions introduced by taxation and to increase the performance of tax administration by modernization, acquiring more technical resource to fight tax evasion notably transnational than to increase the tax burden.

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Appendix

FIGURE 5 – Non-resource tax efficiency according to the level of development

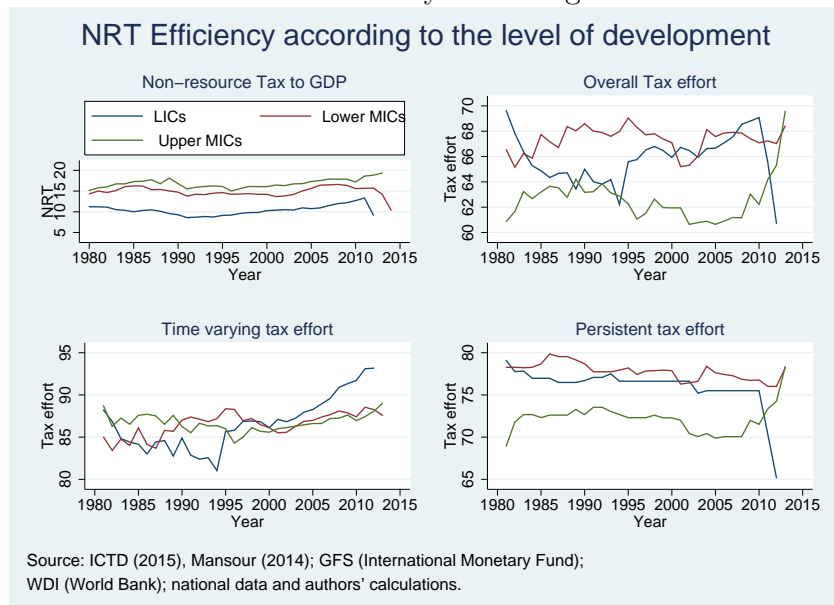


FIGURE 6 – Value-added tax efficiency according to the level of development

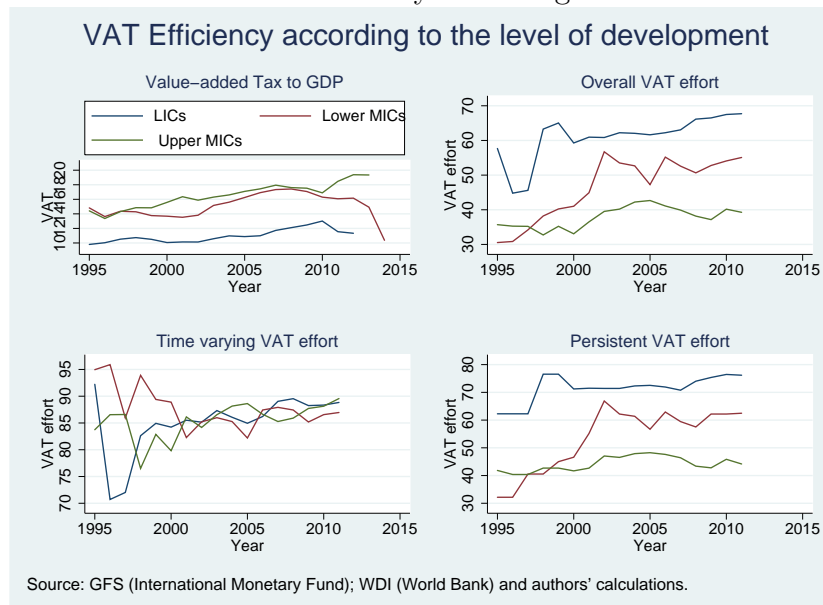
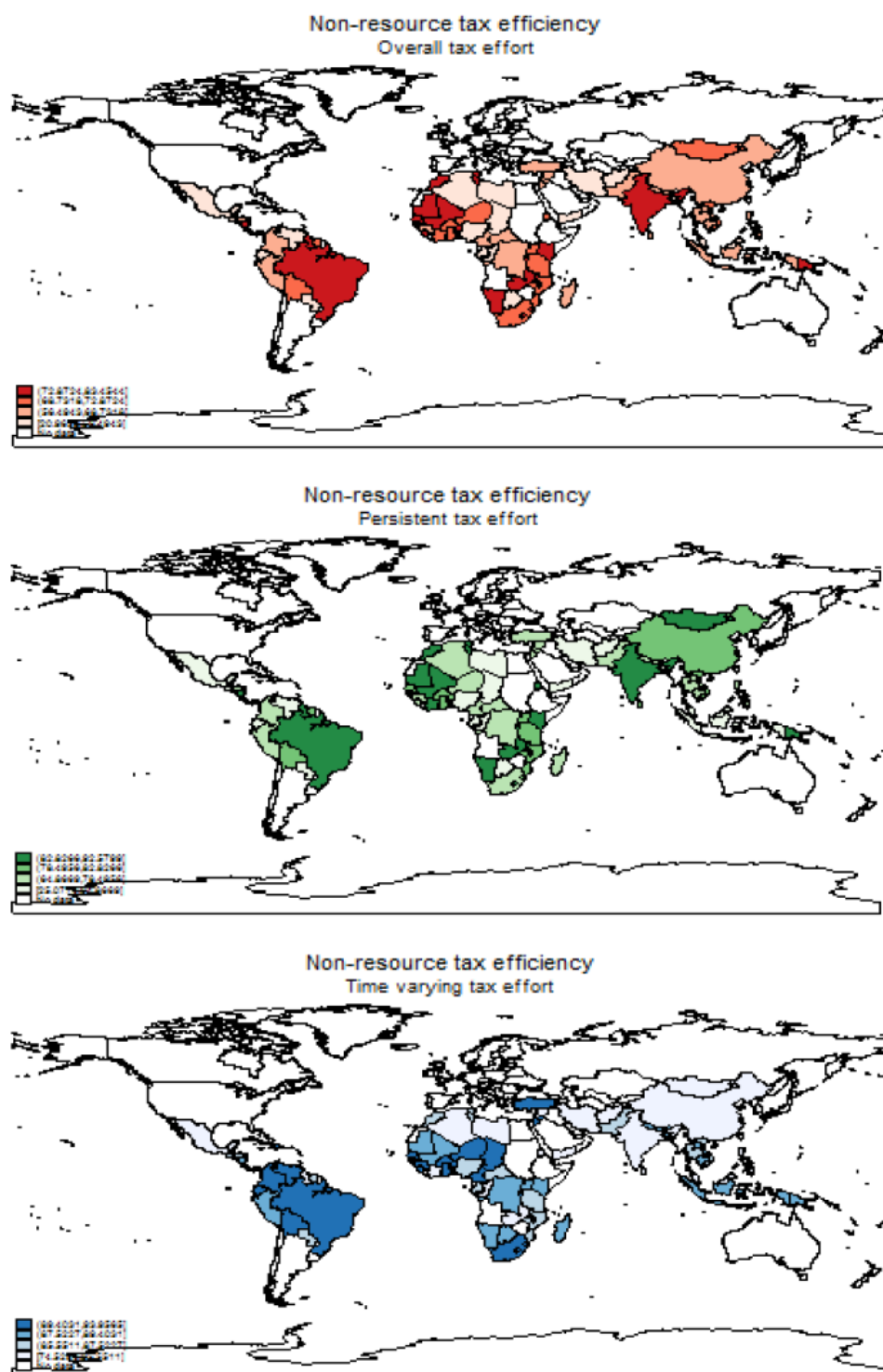
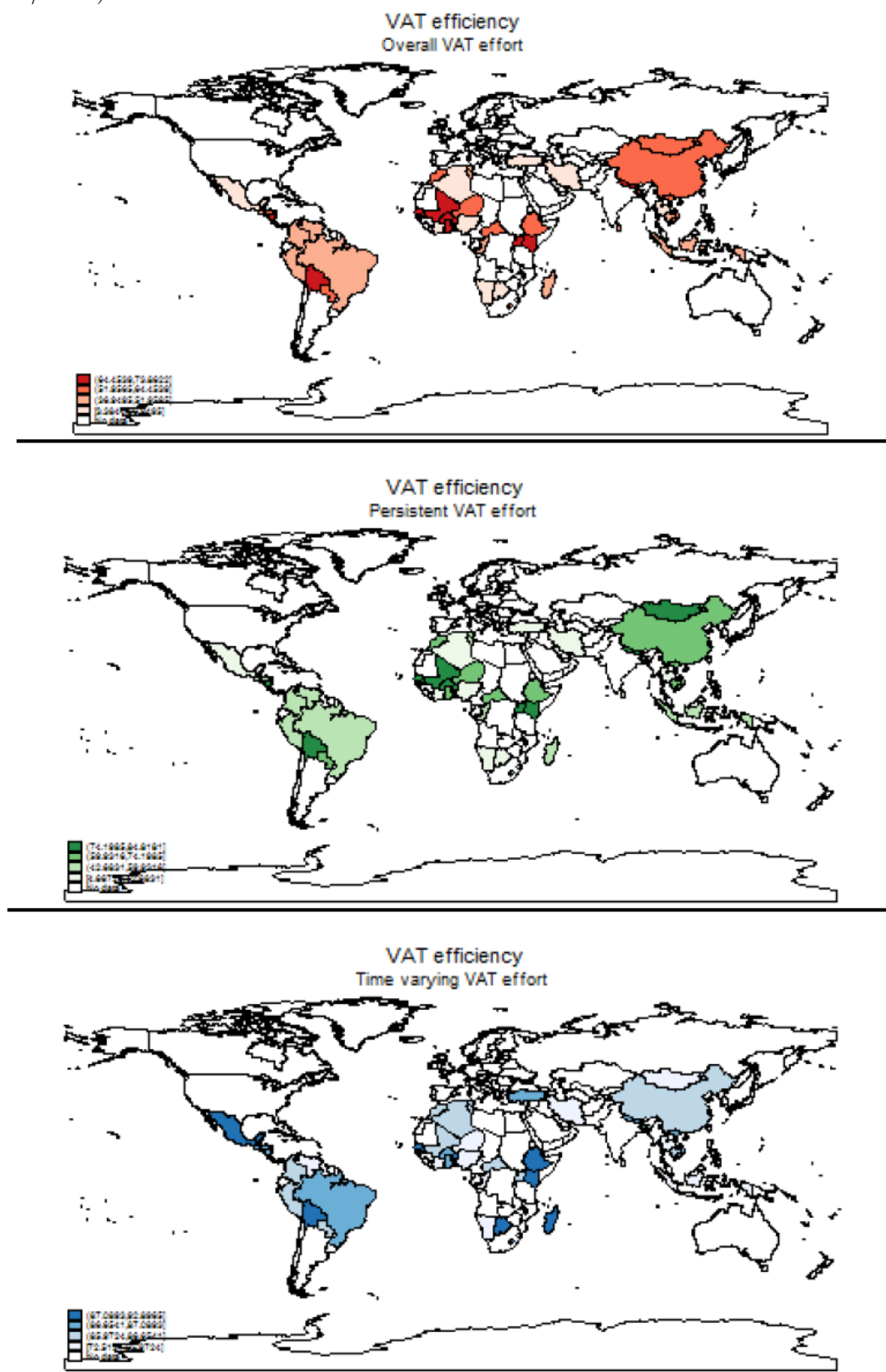


FIGURE 7 – An overview of non-resource tax efficiency around the world over the period(2000/2014)



Source: WMD (Blue Marble Geographics); ICTD (2015); Mansour (2014); GFS (International Monetary Fund); WDI (World Bank); national data and authors' calculations.

FIGURE 8 – An overview of value-added tax efficiency around the world over the period(2000/2014)



Source: WMD (Blue Marble Geographics); GFS (International Monetary Fund); WDI (World Bank) and authors' calculations.

TABLE 8 – Descriptive statistics for the first sample

	mean	Standard deviation	min	max
nonrestax	14.23	6.76	1.2	59
Gdpcap	2024.98	2080.40	69.6	15676
Vagry	22.74	14.24	0.0	72
openness	76.53	41.25	0.0	375
Renty	10.79	13.11	0.0	83
improvsani	52.50	28.73	2.6	100
Rainfall	1414.60	952.18	23.5	4809
Totaltax	16.78	8.37	1.2	80
<i>N</i>	4135			

TABLE 9 – Descriptive statistics for the second sample

	mean	Standard deviation	min	max
vat	4.80	2.17	0.1	15
gdpcap	2184.40	2011.32	127.0	8865
vagry	19.67	13.16	2.0	58
openness	77.61	35.02	15.6	213
renty	9.95	12.74	0.0	77
improvsani	53.91	27.84	3.0	99
rainfall	1381.39	915.50	23.5	4809
nonrestax	14.82	6.12	3.8	59
<i>N</i>	1640			

ABBREVIATIONS IN TABLES BELOW

T_effort = Tax effort

RE = Tax potentials predicted by the Random Effects estimator

GREIV = Tax potentials predicted by the 2GSLs-RE-IV estimator

TN = Tax potentials predicted by the Truncated Normal model of Battese and Coelli (1992)

HN = Tax potentials predicted by the Half Normal model of Battese and Coelli (1992)

KH14 = Tax potentials predicted by the model of Kumbhakar *et al.* (2014)

KH_TP = Tax potentials predicted by the model of Kumbhakar *et al.* (2014) by the upper percentile estimation

KH_Med = Tax potentials predicted by the model of Kumbhakar *et al.* (2014) by the median estimation

TABLE 10 – Non-resource tax potentials and efforts predicted by the random effects and the G2SLS-RE-IV models

	Country	Code	Category	Year	Non- resource Tax to GDP	RE	T_effort (RE)	GREIV	T_effort (GREIV)
1	Afghanistan	AFG	RDC	2010	9.10	10.46	86.95	8.60	105.74
2	Albania	ALB	NRC	2013	17.32	15.60	111.07	19.76	87.66
3	Algeria	DZA	RDC	2010	10.69	15.24	70.09	17.27	61.86
4	Bangladesh	BGD	NRC	2010	9.00	11.91	75.57	10.38	86.76
5	Belize	BLZ	NRC	2010	22.54	17.69	127.45	21.22	106.23
6	Benin	BEN	NRC	2010	16.26	11.40	142.62	10.21	159.26
7	Bhutan	BTN	NRC	2009	9.75	14.14	68.95	14.68	66.42
8	Bolivia	BOL	RDC	2012	21.34	14.01	152.30	13.51	158.00
9	Botswana	BWA	RDC	2010	18.23	20.05	90.90	25.25	72.20
10	Brazil	BRA	NRC	2012	24.60	17.81	138.13	22.80	107.87
11	Burkina Faso	BFA	NRC	2010	12.73	9.33	136.39	8.42	151.13
12	Burundi	BDI	NRC	2010	18.01	7.36	244.81	5.33	337.99
13	Cabo Verde	CPV	NRC	2010	19.13	17.51	109.25	19.05	100.38
14	Cambodia	KHM	NRC	2012	11.33	11.38	99.56	10.85	104.44
15	Cameroon	CMR	RDC	2010	11.54	11.72	98.47	11.35	101.65
16	Central African Republic	CAF	NRC	2010	8.11	7.57	107.16	7.13	113.63
17	Chad	TCD	RDC	2010	9.69	8.01	120.99	8.55	113.32
18	China	CHN	NRC	2012	20.97	16.18	129.65	19.02	110.24
19	Colombia	COL	NRC	2013	20.16	17.07	118.15	20.80	96.95
20	Comoros	COM	NRC	2010	11.14	9.98	111.58	9.61	115.90
21	Congo, Dem. Republic	ZAR	NRC	2010	12.97	9.49	136.70	6.80	190.71
22	Congo, Rep.	COG	RDC	2010	7.49	14.43	51.89	13.86	54.04
23	Costa Rica	CRI	NRC	2012	14.41	19.50	73.93	24.90	57.89
24	Cote d'Ivoire	CIV	NRC	2010	17.37	12.69	136.90	12.19	142.41
25	Cuba	CUB	NRC	2011	34.46	18.15	189.89	22.46	153.43
26	Djibouti	DJI	NRC	2007	20.55	17.09	120.21	14.70	139.76
27	Dominica	DMA	NRC	2013		17.85		24.01	

	Country	Code	Category	Year	Non- resource Tax to GDP	RE	T_effort (RE)	GREIV	T_effort (GREIV)
28	Dominican Republic	DOM	NRC	2012	13.07	18.43	70.94	22.66	57.70
29	Ecuador	ECU	NRC	2012	13.99	16.10	86.84	18.89	74.03
30	Egypt, Arab Rep.	EGY	NRC	2013		13.64		13.78	
31	Eritrea	ERI	NRC	2002	15.11	11.88	127.24	8.57	176.37
32	Ethiopia	ETH	NRC	2013		7.85		6.81	
33	Fiji	FJI	NRC	2011	22.57	18.59	121.41	21.34	105.77
34	Gabon	GAB	RDC	2010	12.34	16.94	72.85	21.46	57.50
35	Gambia	GMB	NRC	2010	12.04	10.41	115.73	9.13	131.87
36	Ghana	GHA	NRC	2010	13.23	10.64	124.34	9.77	135.37
37	Guatemala	GTM	NRC	2012	10.85	15.73	68.99	17.02	63.73
38	Guinea	GIN	RDC	2010	11.04	9.98	110.65	7.48	147.50
39	Guinea-Bissau	GNB	NRC	2010	8.30	8.32	99.71	7.76	106.91
40	Guyana	GUY	NRC	2013		14.51		14.83	
41	Honduras	HND	NRC	2012	15.36	15.88	96.68	16.06	95.60
42	India	IND	RDC	2010	15.71	12.63	124.32	12.21	128.68
43	Indonesia	IDN	RDC	2010	10.65	13.91	76.55	14.28	74.60
44	Iran	IRN	RDC	2010	6.29	15.23	41.27	17.80	35.32
45	Jamaica	JAM	NRC	2012	27.01	18.62	145.07	21.98	122.89
46	Jordan	JOR	NRC	2011	15.40	19.32	79.72	20.53	75.01
47	Kenya	KEN	NRC	2010	18.29	11.02	165.99	10.03	182.32
48	Kiribati	KIR	NRC	2010	19.74	13.35	147.83	13.22	149.30
49	Lao PDR	LAO	NRC	2013	13.09	11.48	114.02	10.79	121.24
50	Lebanon	LBN	NRC	2008	15.89	20.80	76.43	26.61	59.73
51	Lesotho	LSO	NRC	2010	36.77	16.31	225.41	14.01	262.40
52	Libya	LBY	RDC	2008	3.31	16.83	19.68	21.93	15.10
53	Madagascar	MDG	NRC	2010	10.73	10.08	106.37	7.73	138.68
54	Malawi	MWI	NRC	2010	17.44	9.87	176.73	7.60	229.41
55	Malaysia	MYS	RDC	2008	11.58	20.10	57.59	25.41	45.56
56	Maldives	MDV	NRC	2011	13.62	23.39	58.23	27.35	49.79
57	Mali	MLI	NRC	2010	12.37	8.88	139.39	8.19	151.13

	Country	Code	Category	Year	Non- resource Tax to GDP	RE	T_effort (RE)	GREIV	T_effort (GREIV)
58	Mauritania	MRT	RDC	2009	13.42	11.14	120.45	10.13	132.52
59	Mauritius	MUS	NRC	2012	19.17	21.78	88.00	27.71	69.16
60	Mexico	MEX	RDC	2011	9.57	19.88	48.12	26.71	35.81
61	Moldova	MDA	NRC	2013	21.75	15.30	142.14	14.56	149.34
62	Mongolia	MNG	RDC	2007	15.96	12.51	127.60	12.17	131.17
63	Montenegro	MNE	NRC	2013	25.95	18.89	137.41	23.30	111.40
64	Morocco	MAR	NRC	2012	25.46	16.06	158.59	17.72	143.71
65	Mozambique	MOZ	NRC	2010	18.05	10.36	174.19	8.89	202.96
66	Namibia	NAM	NRC	2010	25.15	18.67	134.67	22.33	112.59
67	Nepal	NPL	NRC	2011	12.95	9.11	142.04	8.03	161.15
68	Nicaragua	NIC	NRC	2009	21.98	14.12	155.62	13.78	159.55
69	Niger	NER	NRC	2010	12.27	8.68	141.39	7.15	171.56
70	Nigeria	NGA	RDC	2010	6.82	11.34	60.15	11.18	60.98
71	Pakistan	PAK	NRC	2013	9.92	11.46	86.58	10.91	90.95
72	Panama	PAN	NRC	2012	12.40	22.97	53.98	29.69	41.76
73	Papua New Guinea	PNG	RDC	2004	18.46	9.84	187.56	9.49	194.50
74	Paraguay	PRY	NRC	2012	13.48	15.07	89.46	15.88	84.88
75	Peru	PER	RDC	2012	16.85	16.74	100.67	19.90	84.67
76	Philippines	PHL	NRC	2010	12.15	14.76	82.33	14.64	83.02
77	Rwanda	RWA	NRC	2010	12.04	9.55	126.06	8.14	147.95
78	Senegal	SEN	NRC	2010	18.08	12.93	139.84	11.72	154.28
79	Seychelles	SYC	NRC	2012	28.40	27.58	102.97	39.92	71.15
80	Sierra Leone	SLE	NRC	2010	11.74	7.52	155.98	7.21	162.76
81	Solomon Islands	SLB	NRC	2006	15.34	10.38	147.76	10.52	145.81
82	South Africa	ZAF	NRC	2012	26.91	19.12	140.70	24.00	112.12
83	Sri Lanka	LKA	NRC	2008	13.43	14.73	91.19	14.85	90.43
84	St. Lucia	LCA	NRC	2004	19.89	20.67	96.23	25.97	76.60
85	St. Vincent and the Grenadines	VCT	NRC	2004	18.90	19.38	97.52	23.82	79.36
86	Suriname	SUR	NRC	2005	19.00	17.41	109.15	20.00	95.02

	Country	Code	Category	Year	Non-resource Tax to GDP	TN	T_effort(TN)	HN	T_effort(HN)
1	Afghanistan	AFG	RDC	2010	9.10	44.54	20.42	38.42	23.68
2	Albania	ALB	NRC	2013	17.32	33.77	51.30	27.04	64.07
3	Algeria	DZA	RDC	2010	10.69	30.56	34.96	24.44	43.73
4	Bangladesh	BGD	NRC	2010	9.00	33.61	26.78	27.71	32.49
5	Belize	BLZ	NRC	2010	22.54	44.29	50.90	36.23	62.23
6	Benin	BEN	NRC	2010	16.26	35.75	45.48	29.53	55.07
7	Bhutan	BTN	NRC	2009	9.75	34.69	28.10	28.46	34.25
8	Bolivia	BOL	RDC	2012	21.34	46.72	45.67	38.41	55.56
9	Botswana	BWA	RDC	2010	18.23	62.90	28.98	51.04	35.71
10	Brazil	BRA	NRC	2012	24.60	44.64	55.11	35.19	69.91
11	Burkina Faso	BFA	NRC	2010	12.73	30.50	41.74	25.31	50.30
12	Burundi	BDI	NRC	2010	18.01	22.96	78.45	19.22	93.73
13	Cabo Verde	CPV	NRC	2010	19.13	43.23	44.24	36.06	53.04
14	Cambodia	KHM	NRC	2012	11.33	38.86	29.17	32.75	34.60
15	Cameroon	CMR	RDC	2010	11.54	32.95	35.03	26.76	43.13
16	Central African Republic	CAF	NRC	2010	8.11	20.01	40.52	16.37	49.52
17	Chad	TCD	RDC	2010	9.69	41.15	23.54	33.79	28.67
18	China	CHN	NRC	2012	20.97	42.10	49.81	34.47	60.85
19	Colombia	COL	NRC	2013	20.16	50.67	39.79	40.34	49.99
20	Comoros	COM	NRC	2010	11.14	26.48	42.08	21.67	51.41
21	Congo, Dem. Rep.	ZAR	NRC	2010	12.97	39.43	32.90	32.64	39.74
22	Congo, Rep.	COG	RDC	2010	7.49	22.06	33.95	18.12	41.34
23	Costa Rica	CRI	NRC	2012	14.41	44.09	32.69	35.46	40.65
24	Cote d'Ivoire	CIV	NRC	2010	17.37	30.96	56.09	25.43	68.30
25	Cuba	CUB	NRC	2011	34.46	43.35	79.49	35.62	96.74
26	Djibouti	DJI	NRC	2007	20.55	35.85	57.31	30.22	67.99
27	Dominica	DMA	NRC	1989	28.03	48.22	58.13	37.88	73.99
28	Dominican Republic	DOM	NRC	2012	13.07	45.48	28.74	36.68	35.64

TABLE 11 – Non-resource tax potentials and efforts predicted by the truncated normal and the half models of Battese and Coelli (1992)

	Country	Code	Category	Year	Non-resource Tax to GDP	TN	T_effort(TN)	HN	T_effort(HN)
1	Afghanistan	AFG	RDC	2010	9.10	44.54	20.42	38.42	23.68
2	Albania	ALB	NRC	2013	17.32	33.77	51.30	27.04	64.07
3	Algeria	DZA	RDC	2010	10.69	30.56	34.96	24.44	43.73
4	Bangladesh	BGD	NRC	2010	9.00	33.61	26.78	27.71	32.49
5	Belize	BLZ	NRC	2010	22.54	44.29	50.90	36.23	62.23
6	Benin	BEN	NRC	2010	16.26	35.75	45.48	29.53	55.07
7	Bhutan	BTN	NRC	2009	9.75	34.69	28.10	28.46	34.25
8	Bolivia	BOL	RDC	2012	21.34	46.72	45.67	38.41	55.56
9	Botswana	BWA	RDC	2010	18.23	62.90	28.98	51.04	35.71
10	Brazil	BRA	NRC	2012	24.60	44.64	55.11	35.19	69.91
11	Burkina Faso	BFA	NRC	2010	12.73	30.50	41.74	25.31	50.30
12	Burundi	BDI	NRC	2010	18.01	22.96	78.45	19.22	93.73
13	Cabo Verde	CPV	NRC	2010	19.13	43.23	44.24	36.06	53.04
14	Cambodia	KHM	NRC	2012	11.33	38.86	29.17	32.75	34.60
15	Cameroon	CMR	RDC	2010	11.54	32.95	35.03	26.76	43.13
16	Central African Republic	CAF	NRC	2010	8.11	20.01	40.52	16.37	49.52
17	Chad	TCO	RDC	2010	9.69	41.15	23.54	33.79	28.67
18	China	CHN	NRC	2012	20.97	42.10	49.81	34.47	60.85
19	Colombia	COL	NRC	2013	20.16	50.67	39.79	40.34	49.99
20	Comoros	COM	NRC	2010	11.14	26.48	42.08	21.67	51.41
21	Congo, Dem. Rep.	ZAR	NRC	2010	12.97	39.43	32.90	32.64	39.74
22	Congo, Rep.	COG	RDC	2010	7.49	22.06	33.95	18.12	41.34
23	Costa Rica	CRI	NRC	2012	14.41	44.09	32.69	35.46	40.65
24	Cote d'Ivoire	CIV	NRC	2010	17.37	30.96	56.09	25.43	68.30
25	Cuba	CUB	NRC	2011	34.46	43.35	79.49	35.62	96.74
26	Djibouti	DJI	NRC	2007	20.55	35.85	57.31	30.22	67.99
27	Dominica	DMA	NRC	1989	28.03	48.22	58.13	37.88	73.99
28	Dominican Republic	DOM	NRC	2012	13.07	45.48	28.74	36.68	35.64

	Country	Code	Category	Year	Non- resource Tax to GDP	TN	T_effort(TN)	HN	T_effort(HN)
29	Ecuador	ECU	NRC	2012	13.99	51.40	27.21	41.09	34.03
30	Egypt, Arab Rep.	EGY	NRC	1995	21.13	29.90	70.66	24.47	86.35
31	Eritrea	ERI	NRC	2002	15.11	27.16	55.64	23.16	65.24
32	Fiji	FJI	NRC	2011	22.57	42.54	53.06	34.75	64.95
33	Gabon	GAB	RDC	2010	12.34	37.17	33.20	29.42	41.94
34	Gambia, The	GMB	NRC	2010	12.04	25.79	46.70	21.34	56.42
35	Ghana	GHA	NRC	2010	13.23	32.08	41.24	26.46	50.01
36	Guatemala	GTM	NRC	2012	10.85	36.24	29.94	29.45	36.83
37	Guinea	GIN	RDC	2010	11.04	35.08	31.46	29.53	37.38
38	Guinea-Bissau	GNB	NRC	2010	8.30	34.98	23.71	28.36	29.25
39	Guyana	GUY	NRC	2005	18.35	31.39	58.45	26.78	68.50
40	Honduras	HND	NRC	2012	15.36	36.88	41.65	30.49	50.37
41	India	IND	RDC	2010	15.71	29.40	53.43	24.16	65.02
42	Indonesia	IDN	RDC	2010	10.65	34.31	31.04	28.08	37.92
43	Iran, Islamic Rep.	IRN	RDC	2010	6.29	26.55	23.68	21.05	29.87
44	Jamaica	JAM	NRC	2012	27.01	50.02	54.00	40.44	66.79
45	Jordan	JOR	NRC	2011	15.40	38.14	40.38	31.80	48.43
46	Kenya	KEN	NRC	2010	18.29	33.02	55.37	27.41	66.70
47	Kiribati	KIR	NRC	2010	19.74	38.26	51.60	31.95	61.79
48	Lao PDR	LAO	NRC	2013	13.09	35.39	36.97	29.19	44.83
49	Lebanon	LBN	NRC	2008	15.89	51.24	31.02	40.90	38.86
50	Lesotho	LSO	NRC	2010	36.77	38.68	95.05	37.13	99.03
51	Libya	LBY	RDC	2008	3.31	36.28	9.13	29.68	11.16
52	Madagascar	MDG	NRC	2010	10.73	26.57	40.37	22.19	48.32
53	Malawi	MWI	NRC	2010	17.44	28.67	60.82	24.21	72.02
54	Malaysia	MYS	RDC	2008	11.58	34.07	33.98	28.14	41.14
55	Maldives	MDV	NRC	2011	13.62	56.39	24.15	46.79	29.10
56	Mali	MLI	NRC	2010	12.37	25.58	48.37	21.22	58.29
57	Mauritania	MRT	RDC	2009	13.42	26.19	51.25	21.65	62.00
58	Mauritius	MUS	NRC	2012	19.17	46.15	41.53	37.74	50.79

	Country	Code	Category	Year	Non-resource Tax to GDP	TN	T_effort(TN)	HN	T_effort(HN)
59	Mexico	MEX	RDC	2011	9.57	35.37	27.04	27.56	34.71
60	Moldova	MDA	NRC	2013	21.75	35.53	61.20	30.02	72.43
61	Mongolia	MNG	RDC	2007	15.96	27.94	57.12	23.29	68.53
62	Montenegro	MNE	NRC	2013	25.95	44.42	58.43	35.63	72.84
63	Morocco	MAR	NRC	2012	25.46	38.90	65.47	31.87	79.91
64	Mozambique	MOZ	NRC	2010	18.05	39.09	46.18	32.85	54.96
65	Namibia	NAM	NRC	2010	25.15	43.83	57.37	35.79	70.26
66	Nepal	NPL	NRC	2011	12.95	34.66	37.36	28.68	45.14
67	Nicaragua	NIC	NRC	2009	21.98	41.36	53.14	33.86	64.90
68	Niger	NER	NRC	2010	12.27	31.43	39.03	26.11	46.99
69	Nigeria	NGA	RDC	2010	6.82	28.42	24.00	23.02	29.63
70	Pakistan	PAK	NRC	2013	9.92	27.53	36.03	22.52	44.05
71	Panama	PAN	NRC	2012	12.40	39.98	31.01	32.86	37.74
72	Papua New Guinea	PNG	RDC	2004	18.46	28.24	65.37	23.24	79.44
73	Paraguay	PRY	NRC	2012	13.48	43.88	30.72	36.11	37.34
74	Peru	PER	RDC	2012	16.85	43.47	38.77	34.87	48.34
75	Philippines	PHL	NRC	2010	12.15	31.45	38.63	26.00	46.74
76	Rwanda	RWA	NRC	2010	12.04	27.55	43.70	22.87	52.65
77	Senegal	SEN	NRC	2010	18.08	36.84	49.08	30.64	59.01
78	Seychelles	SYC	NRC	2012	28.40	44.15	64.33	35.49	80.03
79	Sierra Leone	SLE	NRC	2010	11.74	29.20	40.19	24.01	48.88
80	Solomon Islands	SLB	NRC	2006	15.34	31.43	48.80	25.56	59.99
81	South Africa	ZAF	NRC	2012	26.91	57.38	46.89	45.74	58.82
82	Sri Lanka	LKA	NRC	2008	13.43	29.31	45.83	24.17	55.56
83	St. Lucia	LCA	NRC	2004	19.89	44.82	44.38	36.46	54.55
84	St. Vincent and the Grenadines	VCT	NRC	2004	18.90	40.22	46.99	32.56	58.05
85	Suriname	SUR	NRC	2005	19.00	36.88	51.52	29.42	64.57
86	Swaziland	SWZ	NRC	2010	24.43	48.40	50.48	40.78	59.92
87	Syrian Arab Republic	SYR	RDC	2007	10.78	28.72	37.55	23.20	46.49
88	Tanzania	TZA	NRC	2010	15.85	35.56	44.56	29.34	54.01

	Country	Code	Category	Year	Non-resource Tax to GDP	TN	T_effort(TN)	HN	T_effort(HN)
89	Thailand	THA	RDC	2012	17.95	41.72	43.04	34.26	52.41
90	Timor-Leste	TMP	RDC	2003	5.35	32.46	16.47	29.56	18.09
91	Togo	TGO	NRC	2010	15.68	27.83	56.32	23.36	67.12
92	Tonga	TON	NRC	2010	15.80	33.79	46.76	27.28	57.91
93	Tunisia	TUN	NRC	2009	23.11	38.09	60.66	31.06	74.39
94	Turkey	TUR	NRC	2013	21.26	52.88	40.21	41.56	51.16
95	Turkmenistan	TKM	RDC	1998	15.08	29.66	50.85	22.59	66.78
96	Uganda	UGA	NRC	2010	11.78	28.85	40.83	23.86	49.37
97	Vanuatu	VUT	NRC	2010	16.49	35.06	47.03	28.74	57.37
98	Venezuela, RB	VEN	RDC	2010	10.01	42.65	23.48	33.66	29.75
99	Vietnam	VNM	RDC	2012	15.16	34.87	43.48	29.35	51.64
100	Yemen, Rep.	YEM	RDC	2003	6.73	25.24	26.65	20.85	32.25
101	Zambia	ZMB	NRC	2010	14.95	24.88	60.08	20.77	71.98

Source: ICTD (2015); Mansour (2014); GFS (International Monetary Fund); WDI (World Bank); national data and authors' calculations.

TABLE 12 – LICs' non-resource tax potentials and efforts predicted by the model of Kumbhakar, Lien and Hardaker (2014)

	Country	Code	Category	Year	Non-resource Tax to GDP	KH14	Overall T_effort	Time-varying T_effort	Persistent T_effort
1	Afghanistan	AFG	RDC	2010	9.10	18.25	49.86	95.09	52.43
2	Bangladesh	BGD	NRC	2010	9.00	16.41	54.86	90.29	60.76
3	Benin	BEN	NRC	2010	16.26	21.80	74.58	91.99	81.07
4	Burkina Faso	BFA	NRC	2010	12.73	17.42	73.07	92.32	79.14
5	Burundi	BDI	NRC	2010	18.01	21.79	82.68	90.05	91.81
6	Cambodia	KHM	NRC	2012	11.33	18.66	60.73	93.17	65.18
7	Central African Republic	CAF	NRC	2010	8.11	11.83	68.55	88.17	77.74
8	Chad	TCD	RDC	2010	9.69	18.20	53.24	96.61	55.11
9	Comoros	COM	NRC	2010	11.14	16.01	69.59	88.55	78.59
10	Congo, Dem. Rep.	ZAR	NRC	2010	12.97	19.76	65.65	95.42	68.81
11	Eritrea	ERI	NRC	2002	15.11	21.13	71.51	82.75	86.42
12	Gambia, The	GMB	NRC	2010	12.04	17.05	70.64	85.62	82.51
13	Guinea	GIN	RDC	2010	11.04	17.61	62.68	94.01	66.67
14	Guinea-Bissau	GNB	NRC	2010	8.30	15.85	52.35	95.64	54.74
15	Kenya	KEN	NRC	2010	18.29	23.38	78.23	91.10	85.87
16	Madagascar	MDG	NRC	2010	10.73	15.74	68.15	88.70	76.83
17	Malawi	MWI	NRC	2010	17.44	22.06	79.04	89.60	88.21
18	Mali	MLI	NRC	2010	12.37	16.52	74.88	89.80	83.38
19	Mozambique	MOZ	NRC	2010	18.05	23.31	77.44	94.07	82.32
20	Nepal	NPL	NRC	2011	12.95	18.19	71.19	94.23	75.55
21	Niger	NER	NRC	2010	12.27	17.11	71.71	93.94	76.34
22	Rwanda	RWA	NRC	2010	12.04	16.61	72.51	89.76	80.78
23	Sierra Leone	SLE	NRC	2010	11.74	15.97	73.50	94.52	77.76
24	Tanzania	TZA	NRC	2010	15.85	20.89	75.84	93.26	81.32
25	Togo	TGO	NRC	2010	15.68	20.62	76.04	88.66	85.77
26	Uganda	UGA	NRC	2010	11.78	16.65	70.75	89.74	78.84

Source: ICTD (2015); Mansour (2014); GFS (International Monetary Fund); WDI (World Bank); national data and authors' calculations.

TABLE 13 – LMICs' non-resource tax potentials and efforts predicted by the model of Kumbhakar, Lien and Hardaker (2014)

	Country	Code	Category	Year	Non-resource Tax to GDP	KH14	Overall T_effort	Time- varying T_effort	Persistent T_effort
1	Bhutan	BTN	NRC	2009	9.75	18.18	53.63	87.89	61.01
2	Bolivia	BOL	RDC	2012	21.34	28.57	74.69	93.54	79.85
3	Cabo Verde	CPV	NRC	2010	19.13	27.67	69.13	88.06	78.50
4	Cameroon	CMR	RDC	2010	11.54	18.20	63.42	91.36	69.42
5	Congo, Rep.	COG	RDC	2010	7.49	15.71	47.67	74.99	63.57
6	Cote d'Ivoire	CIV	NRC	2010	17.37	23.34	74.42	87.64	84.91
7	Djibouti	DJI	NRC	2007	20.55	29.15	70.50	82.54	85.40
8	Egypt, Arab Rep.	EGY	NRC	1995	21.13	27.67	76.37	85.38	89.44
9	Ghana	GHA	NRC	2010	13.23	18.45	71.71	90.71	79.06
10	Guatemala	GTM	NRC	2012	10.85	19.85	54.65	86.16	63.43
11	Guyana	GUY	NRC	2005	18.35	24.91	73.65	85.75	85.89
12	Honduras	HND	NRC	2012	15.36	23.34	65.80	87.03	75.60
13	India	IND	RDC	2010	15.71	21.91	71.69	84.16	85.18
14	Indonesia	IDN	RDC	2010	10.65	18.62	57.21	88.19	64.87
15	Kiribati	KIR	NRC	2010	19.74	26.02	75.87	91.19	83.20
16	Lao PDR	LAO	NRC	2013	13.09	19.12	68.46	91.44	74.87
17	Lesotho	LSO	NRC	2010	36.77	46.67	78.79	85.10	92.58
18	Mauritania	MRT	RDC	2009	13.42	18.79	71.43	85.32	83.72
19	Moldova	MDA	NRC	2013	21.75	29.29	74.25	85.15	87.20
20	Mongolia	MNG	RDC	2007	15.96	22.11	72.19	84.28	85.65
21	Morocco	MAR	NRC	2012	25.46	33.19	76.73	87.31	87.88
22	Nicaragua	NIC	NRC	2009	21.98	28.56	76.97	91.18	84.42
23	Nigeria	NGA	RDC	2010	6.82	14.25	47.87	89.16	53.69
24	Pakistan	PAK	NRC	2013	9.92	15.86	62.54	86.16	72.59
25	Papua New Guinea	PNG	RDC	2004	18.46	23.03	80.17	90.89	88.20
26	Paraguay	PRY	NRC	2012	13.48	23.02	58.58	92.18	63.55
27	Philippines	PHL	NRC	2010	12.15	19.76	61.49	83.45	73.69
28	Senegal	SEN	NRC	2010	18.08	24.22	74.65	90.97	82.06
29	Solomon Islands	SLB	NRC	2006	15.34	20.32	75.49	91.95	82.10
30	Sri Lanka	LKA	NRC	2008	13.43	20.97	64.04	79.75	80.29
31	Swaziland	SWZ	NRC	2010	24.43	33.21	73.58	90.49	81.31
32	Syrian Arab Republic	SYR	RDC	2007	10.78	17.67	61.02	83.98	72.66
33	Timor-Leste	TMP	RDC	2003	5.35	13.98	38.24	87.58	43.66
34	Vanuatu	VUT	NRC	2010	16.49	23.67	69.66	87.32	79.78
35	Vietnam	VNM	RDC	2012	15.16	22.15	68.43	86.44	79.17
36	Yemen, Rep.	YEM	RDC	2003	6.73	13.91	48.37	81.70	59.20
37	Zambia	ZMB	NRC	2010	14.95	22.13	67.56	78.07	86.54

Source: ICTD (2015); Mansour (2014); GFS (International Monetary Fund); WDI (World Bank); national data and authors' calculations.

TABLE 14 – UPMICs' non-resource tax potentials and efforts predicted by the model of Kumbhakar, Lien and Hardaker (2014)

	Country	Code	Category	Year	Non-resource Tax to GDP	KH14	Overall T_effort	Time-varying T_effort	Persistent T_effort
1	Albania	ALB	NRC	2013	17.32	24.96	69.39	83.77	82.83
2	Algeria	DZA	RDC	2010	10.69	19.07	56.03	84.08	66.64
3	Belize	BLZ	NRC	2010	22.54	30.95	72.84	89.56	81.33
4	Botswana	BWA	RDC	2010	18.23	33.57	54.30	94.28	57.59
5	Brazil	BRA	NRC	2012	24.60	32.93	74.72	89.46	83.52
6	China	CHN	NRC	2012	20.97	28.60	73.33	89.15	82.25
7	Colombia	COL	NRC	2004	16.33	24.80	65.85	90.18	73.01
8	Costa Rica	CRI	NRC	2012	14.41	25.59	56.33	87.61	64.30
9	Cuba	CUB	NRC	2011	34.46	43.67	78.91	87.38	90.31
10	Dominica	DMA	NRC	1989	28.03	35.70	78.51	91.66	85.65
11	Dominican Republic	DOM	NRC	2012	13.07	24.55	53.25	89.62	59.42
12	Ecuador	ECU	NRC	2012	13.99	25.82	54.17	93.73	57.79
13	Fiji	FJI	NRC	2011	22.57	31.40	71.88	87.29	82.35
14	Gabon	GAB	RDC	2010	12.34	22.15	55.70	87.76	63.47
15	Iran, Islamic Rep.	IRN	RDC	2010	6.29	15.68	40.09	79.53	50.41
16	Jamaica	JAM	NRC	2012	27.01	35.80	75.46	91.13	82.80
17	Jordan	JOR	NRC	2011	15.40	25.43	60.56	82.83	73.11
18	Lebanon	LBN	NRC	2008	15.89	28.38	56.01	89.58	62.52
19	Libya	LBY	RDC	2008	3.31	15.03	22.04	87.88	25.08
20	Malaysia	MYS	RDC	2008	11.58	22.88	50.59	78.46	64.48
21	Maldives	MDV	NRC	2011	13.62	28.99	46.98	88.93	52.82
22	Mauritius	MUS	NRC	2012	19.17	30.40	63.06	86.22	73.14
23	Mexico	MEX	RDC	2011	9.57	21.72	44.05	82.17	53.60
24	Montenegro	MNE	NRC	2013	25.95	34.84	74.51	87.75	84.91
25	Namibia	NAM	NRC	2010	25.15	33.91	74.15	88.00	84.26
26	Panama	PAN	NRC	2012	12.40	25.84	47.99	81.12	59.16
27	Peru	PER	RDC	2012	16.85	25.72	65.53	90.09	72.73
28	Seychelles	SYC	NRC	2012	28.40	43.68	65.02	76.04	85.50
29	South Africa	ZAF	NRC	2012	26.91	36.93	72.85	93.23	78.14
30	St. Lucia	LCA	NRC	2004	19.89	30.20	65.87	86.06	76.54
31	St. Vincent and the Grenadines	VCT	NRC	2004	18.90	28.50	66.33	83.76	79.19
32	Suriname	SUR	NRC	2005	19.00	27.52	69.05	83.95	82.25
33	Thailand	THA	RDC	2012	17.95	27.26	65.87	86.84	75.85
34	Tonga	TON	NRC	2010	15.80	23.09	68.42	85.55	79.98
35	Tunisia	TUN	NRC	2009	23.11	31.93	72.35	84.22	85.91
36	Turkey	TUR	NRC	2013	21.26	31.91	66.65	91.69	72.68
37	Turkmenistan	TKM	RDC	1998	15.08	20.47	73.68	89.24	82.57
38	Venezuela, RB	VEN	RDC	2010	10.01	22.17	45.17	90.44	49.94

(Source: ICTD (2015); Mansour (2014); GFS (International Monetary Fund); WDI (World Bank); national data and authors' calculations.)

TABLE 15 – LICs' non-resource tax potentials and efforts predicted by the model of Kumbhakar, Lien and Hardaker (2014) by the top ten percentile and median estimations

Country	Code	Cate- gory	Year	Non-resource Tax to GDP	KH_TP	Overall T_effort (KH_TP)	Time- varying T_effort (KH_TP)	Persistent T_effort (KH_TP)	KH_ Med	Overall T_effort (KH_Med)	Time- varying T_effort (KH_Med)	Persistent T_effort (KH_Med)
Afghanistan	AFG	RDC	2010	9.1	18.25	49.86	83.99	55.11	13.16	69.13	88.95	77.95
Bangladesh	BGD	NRC	2010	9	18.06	49.86	83.99	55.11	13.02	69.13	88.95	77.95
Benin	BEN	NRC	2010	16.26	32.62	49.86	83.99	55.11	23.52	69.13	88.95	77.95
Burkina Faso	BFA	NRC	2010	12.73	25.54	49.86	83.99	55.11	18.42	69.13	88.95	77.95
Burundi	BDI	NRC	2010	18.01	36.13	49.86	83.99	55.11	26.06	69.13	88.95	77.95
Cambodia	KHM	NRC	2012	11.33	20.92	54.17	84.71	59.42	17.19	65.93	88.38	75.24
Central African Republic	CAF	NRC	2010	8.11	16.26	49.86	83.99	55.11	11.73	69.13	88.95	77.95
Chad	TCD	RDC	2010	9.69	19.43	49.86	83.99	55.11	14.01	69.13	88.95	77.95
Comoros	COM	NRC	2010	11.14	22.35	49.86	83.99	55.11	16.12	69.13	88.95	77.95
Congo, Dem. Rep.	ZAR	NRC	2010	12.97	26.02	49.86	83.99	55.11	18.76	69.13	88.95	77.95
Eritrea	ERI	NRC	2002	15.11	30.83	49	80.39	57.59	22.57	66.96	86.91	78.32
Gambia, The	GMB	NRC	2010	12.04	24.16	49.86	83.99	55.11	17.42	69.13	88.95	77.95
Guinea	GIN	RDC	2010	11.04	22.14	49.86	83.99	55.11	15.97	69.13	88.95	77.95
Guinea- Bissau	GNB	NRC	2010	8.3	16.64	49.86	83.99	55.11	12	69.13	88.95	77.95

	Country	Code	Cate- gory	Year	Non- resource Tax to GDP	KH_TP	Overall T_effort (KH_TP)	Time- varying T_effort (KH_TP)	Persistent T_effort (KH_TP)	KH_Med	Overall T_effort (KH_Med)	Time- varying T_effort (KH_Med)	Persistent T_effort (KH_Med)
15	Kenya	KEN	NRC	2010	18.29	36.68	49.86	83.99	55.11	26.45	69.13	88.95	77.95
16	Madagascar	MDG	NRC	2010	10.73	21.51	49.86	83.99	55.11	15.51	69.13	88.95	77.95
17	Malawi	MWI	NRC	2010	17.44	34.97	49.86	83.99	55.11	25.22	69.13	88.95	77.95
18	Mali	MLI	NRC	2010	12.37	24.82	49.86	83.99	55.11	17.9	69.13	88.95	77.95
19	Mozambique	MOZ	NRC	2010	18.05	36.21	49.86	83.99	55.11	26.11	69.13	88.95	77.95
20	Nepal	NPL	NRC	2011	12.95	24.75	52.31	82.83	59.16	19.23	67.32	87.82	75.21
21	Niger	NER	NRC	2010	12.27	24.61	49.86	83.99	55.11	17.75	69.13	88.95	77.95
22	Rwanda	RWA	NRC	2010	12.04	24.15	49.86	83.99	55.11	17.42	69.13	88.95	77.95
23	Sierra Leone	SLE	NRC	2010	11.74	23.54	49.86	83.99	55.11	16.98	69.13	88.95	77.95
24	Tanzania	TZA	NRC	2010	15.85	31.78	49.86	83.99	55.11	22.92	69.13	88.95	77.95
25	Togo	TGO	NRC	2010	15.68	31.44	49.86	83.99	55.11	22.68	69.13	88.95	77.95
26	Uganda	UGA	NRC	2010	11.78	23.63	49.86	83.99	55.11	17.04	69.13	88.95	77.95

Source: ICTD (2015); Mansour (2014); GFS (International Monetary Fund); WDI (World Bank); national data and authors' calculations.

TABLE 16 – LMICs' non-resource tax potentials and efforts predicted by the model of Kumbhakar, Lien and Hardaker (2014) by the top 10 percentile and median estimations

Country	Code	Category	Year	Non- resource Tax to GDP	KH_TP	Overall T_effort (KH_TP)	Time Varying T_effort (KH_TP)	Persistent T_effort (KH_TP)	KH_Med	Overall T_effort (KH_Med)	Time Varying T_effort (KH_Med)	Persistent T_effort (KH_Med)
Blutan	BTN	NRC	2009	9.75	18.87	51.65	83.99	57.59	13.99	69.69	89.38	78.32
Bolivia	BOL	RDC	2012	21.34	39.40	54.17	84.71	59.42	32.37	65.93	88.38	75.24
Cabo Verde	CPV	NRC	2010	19.13	38.36	49.86	83.99	55.11	27.67	69.13	88.95	77.95
Cameroon	CMR	RDC	2010	11.54	23.15	49.86	83.99	55.11	16.69	69.13	88.95	77.95

Country	Code	Category	Year	Non-resource Tax to GDP	KH_TP	Overall T_effort (KH_TP)	Time Varying T_effort (KH_TP)	Persistent T_effort (KH_TP)	KH_Med	Overall T_effort (KH_Med)	Time Varying T_effort (KH_Med)	Persistent T_effort (KH_Med)
Congo, Rep.	COG	RDC	2010	7.49	15.02	49.86	83.99	55.11	10.83	69.13	88.95	77.95
Cote d'Ivoire	CIV	NRC	2010	17.37	34.83	49.86	83.99	55.11	25.12	69.13	88.95	77.95
Djibouti	DJI	NRC	2007	20.55	43.76	46.96	82.04	55.11	29.98	68.54	88.83	78.14
Egypt, Arab Rep.	EGY	NRC	1995	21.13	40.53	52.14	80.57	59.18	30.98	68.21	87.58	78.95
Ghana	GHA	NRC	2010	13.23	26.54	49.86	83.99	55.11	19.14	69.13	88.95	77.95
Guatemala	GTM	NRC	2012	10.85	20.03	54.17	84.71	59.42	16.45	65.93	88.38	75.24
Guyana	GUY	NRC	2005	18.35	38.47	47.68	81.24	55.11	27.22	67.39	87.83	78.50
Honduras	HND	NRC	2012	15.36	28.35	54.17	84.71	59.42	23.29	65.93	88.38	75.24
India	IND	RDC	2010	15.71	31.51	49.86	83.99	55.11	22.72	69.13	88.95	77.95
Indonesia	IDN	RDC	2010	10.65	21.36	49.86	83.99	55.11	15.41	69.13	88.95	77.95
Kiribati	KIR	NRC	2010	19.74	39.60	49.86	83.99	55.11	28.56	69.13	88.95	77.95
Lao PDR	LAO	NRC	2013	13.09	20.92	62.54	83.77	72.59	19.12	68.46	87.75	74.87
Lesotho	LSO	NRC	2010	36.77	73.75	49.86	83.99	55.11	53.19	69.13	88.95	77.95
Mauritania	MRT	RDC	2009	13.42	25.99	51.65	83.99	57.59	19.26	69.69	89.38	78.32
Moldova	MDA	NRC	2013	21.75	34.77	62.54	83.77	72.59	31.76	68.46	87.75	74.87
Mongolia	MNG	RDC	2007	15.96	33.99	46.96	82.04	55.11	23.29	68.54	88.83	78.14
Morocco	MAR	NRC	2012	25.46	47.01	54.17	84.71	59.42	38.62	65.93	88.38	75.24
Nicaragua	NIC	NRC	2009	21.98	42.55	51.65	83.99	57.59	31.54	69.69	89.38	78.32
Nigeria	NGA	RDC	2010	6.82	13.68	49.86	83.99	55.11	9.87	69.13	88.95	77.95
Pakistan	PAK	NRC	2013	9.92	15.86	62.54	83.77	72.59	14.49	68.46	87.75	74.87
Papua New Guinea	PNG	RDC	2004	18.46	37.84	48.80	82.26	57.59	27.25	67.77	87.46	78.54
Paraguay	PRY	NRC	2012	13.48	24.89	54.17	84.71	59.42	20.45	65.93	88.38	75.24
Philippines	PHL	NRC	2010	12.15	24.37	49.86	83.99	55.11	17.58	69.13	88.95	77.95
Senegal	SEN	NRC	2010	18.08	36.26	49.86	83.99	55.11	26.15	69.13	88.95	77.95
Solomon Islands	SLB	NRC	2006	15.34	31.84	48.17	80.75	56.35	22.33	68.68	88.71	78.32

Country	Code	Category	Year	Non-resource Tax to GDP	KH_TP	Overall T_effort (KH_TP)	Time Varying T_effort (KH_TP)	Persistent T_effort (KH_TP)	KH_Med	Overall T_effort (KH_Med)	Time Varying T_effort (KH_Med)	Persistent T_effort (KH_Med)
Sri Lanka	LKA	NRC	2008	13.43	28.94	46.42	83.07	55.11	19.37	69.32	89.88	77.95
Swaziland	SWZ	NRC	2010	24.43	49.01	49.86	83.99	55.11	35.35	69.13	88.95	77.95
Syrian Arab Republic	SYR	RDC	2007	10.78	22.97	46.96	82.04	55.11	15.73	68.54	88.83	78.14
Timor-Leste	TMP	RDC	2003	5.35	11.05	48.37	81.31	55.11	7.94	67.33	87.38	77.76
Vanuatu	VUT	NRC	2010	16.49	33.07	49.86	83.99	55.11	23.85	69.13	88.95	77.95
Vietnam	VNM	RDC	2012	15.16	27.99	54.17	84.71	59.42	22.99	65.93	88.38	75.24
Yemen, Rep.	YEM	RDC	2003	6.73	13.91	48.37	81.31	55.11	9.99	67.33	87.38	77.76
Zambia	ZMB	NRC	2010	14.95	29.99	49.86	83.99	55.11	21.63	69.13	88.95	77.95

Source: ICTD (2015); Mansour (2014); GFS (International Monetary Fund); WDI (World Bank); national data and authors' calculations.

TABLE 17 – UMICs' non-resource tax potentials and efforts predicted by the model of Kumbhakar, Lien and Hardaker (2014) by the top 10 percentile and median estimations

Country	Code	Category	Year	Non-resource Tax to GDP	KH_TP	Overall T_effort (KH_TP)	Time Varying T_effort (KH_TP)	Persistent T_effort (KH_TP)	KH_Med	Overall T_effort (KH_Med)	Time Varying T_effort (KH_Med)	Persistent T_effort (KH_Med)
Albania	ALB	NRC	2013	17.32	27.69	62.54	83.77	72.59	25.30	68.46	87.75	74.87
Algeria	DZA	RDC	2010	10.69	21.43	49.86	83.99	55.11	15.46	69.13	88.95	77.95
Belize	BLZ	NRC	2010	22.54	45.22	49.86	83.99	55.11	32.61	69.13	88.95	77.95
Botswana	BWA	RDC	2010	18.23	36.56	49.86	83.99	55.11	26.37	69.13	88.95	77.95
Brazil	BRA	NRC	2012	24.60	45.42	54.17	84.71	59.42	37.31	65.93	88.38	75.24
China	CHN	NRC	2012	20.97	38.72	54.17	84.71	59.42	31.81	65.93	88.38	75.24
Colombia	COL	NRC	2004	16.33	33.47	48.80	82.26	57.59	24.10	67.77	87.46	78.54
Costa Rica	CRI	NRC	2012	14.41	26.61	54.17	84.71	59.42	21.86	65.93	88.38	75.24
Cuba	CUB	NRC	2011	34.46	65.88	52.31	82.83	59.16	51.18	67.32	87.82	75.21
Dominica	DMA	NRC	1989	28.03	55.82	50.22	72.34	59.16	41.73	67.17	87.05	78.84
Dominican Republic	DOM	NRC	2012	13.07	24.14	54.17	84.71	59.42	19.83	65.93	88.38	75.24
Ecuador	ECU	NRC	2012	13.99	25.82	54.17	84.71	59.42	21.21	65.93	88.38	75.24
Fiji	FJI	NRC	2011	22.57	43.15	52.31	82.83	59.16	33.52	67.32	87.82	75.21
Gabon	GAB	RDC	2010	12.34	24.75	49.86	83.99	55.11	17.85	69.13	88.95	77.95
Iran, Islamic Rep.	IRN	RDC	2010	6.29	12.61	49.86	83.99	55.11	9.09	69.13	88.95	77.95
Jamaica	JAM	NRC	2012	27.01	49.87	54.17	84.71	59.42	40.97	65.93	88.38	75.24
Jordan	JOR	NRC	2011	15.40	29.44	52.31	82.83	59.16	22.88	67.32	87.82	75.21
Lebanon	LBN	NRC	2008	15.89	34.24	46.42	83.07	55.11	22.93	69.32	89.88	77.95
Libya	LYB	RDC	2008	3.31	7.13	46.42	83.07	55.11	4.78	69.32	89.88	77.95
Malaysia	MYS	RDC	2008	11.58	24.94	46.42	83.07	55.11	16.70	69.32	89.88	77.95
Maldives	MDV	NRC	2011	13.62	26.03	52.31	82.83	59.16	20.23	67.32	87.82	75.21

Country	Code	Category	Year	Non-resource Tax to GDP	KH_TP	Overall T_effort (KH_TP)	Time Varying T_effort (KH_TP)	Persistent T_effort (KH_TP)	KH_Med	Overall T_effort (KH_Med)	Time Varying T_effort (KH_Med)	Persistent T_effort (KH_Med)
Mauritius	MUS	NRC	2012	19.17	35.39	54.17	84.71	59.42	29.07	65.93	88.38	75.24
Mexico	MEX	RDC	2011	9.57	18.29	52.31	82.83	59.16	14.21	67.32	87.82	75.21
Montenegro	MNE	NRC	2013	25.95	41.50	62.54	83.77	72.59	37.91	68.46	87.75	74.87
Namibia	NAM	NRC	2010	25.15	50.44	49.86	83.99	55.11	36.38	69.13	88.95	77.95
Panama	PAN	NRC	2012	12.40	22.89	54.17	84.71	59.42	18.81	65.93	88.38	75.24
Peru	PER	RDC	2012	16.85	31.11	54.17	84.71	59.42	25.56	65.93	88.38	75.24
Seychelles	SYC	NRC	2012	28.40	52.43	54.17	84.71	59.42	43.08	65.93	88.38	75.24
South Africa	ZAF	NRC	2012	26.91	49.67	54.17	84.71	59.42	40.81	65.93	88.38	75.24
St. Lucia	LCA	NRC	2004	19.89	40.77	48.80	82.26	57.59	29.35	67.77	87.46	78.54
St. Vincent and the Grenadines	VCT	NRC	2004	18.90	38.73	48.80	82.26	57.59	27.89	67.77	87.46	78.54
Suriname	SUR	NRC	2005	19.00	39.84	47.68	81.24	55.11	28.19	67.39	87.83	78.50
Thailand	THA	RDC	2012	17.95	33.15	54.17	84.71	59.42	27.23	65.93	88.38	75.24
Tonga	TON	NRC	2010	15.80	31.69	49.86	83.99	55.11	22.86	69.13	88.95	77.95
Tunisia	TUN	NRC	2009	23.11	44.73	51.65	83.99	57.59	33.15	69.69	89.38	78.32
Turkey	TUR	NRC	2013	21.26	34.00	62.54	83.77	72.59	31.06	68.46	87.75	74.87
Turkmenistan	TKM	RDC	1998	15.08	29.45	51.22	82.53	59.18	22.13	68.15	87.78	78.95
Venezuela, RB	VEN	RDC	2010	10.01	20.09	49.86	83.99	55.11	14.49	69.13	88.95	77.95

Source: ICTD (2015); Mansour (2014); GFS (International Monetary Fund); WDI (World Bank); national data and authors' calculations.

TABLE 18 – Value-added potentials and efforts predicted by the random effects and the G2SLS-RE-IV models

	Country	Code	Category	Year	VAT revenues to GDP	RE	T_effort (RE)	GREIV	T_effort (GREIV)
1	Albania	ALB	NRC	2011	9.10	6.21	146.52	6.35	143.20
2	Algeria	DZA	RDC	2011	3.50	5.36	65.34	5.20	67.36
3	Bangladesh	BGD	NRC	2011	3.70	2.95	125.37	2.89	128.24
4	Benin	BEN	NRC	2011	7.00	2.78	251.43	2.71	258.20
5	Bolivia	BOL	RDC	2007	7.10	3.39	209.72	3.23	219.81
6	Botswana	BWA	RDC	2011	4.50	8.96	50.20	8.98	50.12
7	Brazil	BRA	NRC	2011	7.90	7.18	110.04	7.20	109.72
8	Burkina Faso	BFA	NRC	2011	6.20	2.18	284.13	2.16	287.21
9	Burundi	BDI	NRC	2013		1.23		1.17	
10	Cambodia	KHM	NRC	2010	3.70	2.86	129.23	2.89	127.96
11	Cameroon	CMR	RDC	2013		3.27		3.24	
12	Cape Verde	CPV	NRC	2007	8.80	5.90	149.21	6.06	145.14
13	Central African Republic	CAF	NRC	2009	2.50	1.62	154.06	1.65	151.18
14	China	CHN	NRC	2010	5.90	5.41	109.15	5.50	107.37
15	Colombia	COL	NRC	2011	5.20	6.17	84.26	6.19	84.06
16	Congo, Rep.	COG	RDC	2005	2.30	4.04	56.96	3.77	60.98
17	Dominica	DMA	NRC	2011	9.10	8.19	111.08	8.31	109.51
18	Dominican Republic	DOM	NRC	2010	4.30	7.16	60.07	7.28	59.10
19	Ethiopia	ETH	NRC	2011	1.90	1.50	126.80	1.52	125.07
20	Fiji	FJI	NRC	2005	8.20	7.18	114.22	7.17	114.42
21	Ghana	GHA	NRC	2011	4.70	2.74	171.73	2.76	170.41
22	Guatemala	GTM	NRC	2011	5.30	5.25	100.90	5.18	102.25
23	Honduras	HND	NRC	2011	5.80	5.07	114.39	4.98	116.38
24	Indonesia	IDN	RDC	2011	3.70	4.24	87.36	4.19	88.35
25	Iran, Islamic Rep.	IRN	RDC	2009	0.50	5.43	9.20	5.29	9.45
26	Jamaica	JAM	NRC	2007	7.50	7.92	94.64	7.83	95.85
27	Kenya	KEN	NRC	2010	5.60	2.67	209.84	2.67	210.09

	Country	Code	Category	Year	VAT revenues to GDP	RE	T_effort (RE)	GREIV	T_effort (GREIV)
28	Lebanon	LBN	NRC	2009	4.90	9.15	53.55	9.39	52.16
29	Lesotho	LSO	NRC	2008	7.40	4.63	159.76	4.42	167.32
30	Madagascar	MDG	NRC	2008	2.20	2.23	98.70	2.15	102.25
31	Mali	MLI	NRC	2010	5.50	2.02	272.16	2.03	271.33
32	Mauritius	MUS	NRC	2011	7.00	9.78	71.55	9.83	71.19
33	Mexico	MEX	RDC	2011	3.80	9.04	42.06	9.07	41.92
34	Moldova	MDA	NRC	2011	12.70	4.48	283.71	4.42	287.29
35	Mongolia	MNG	RDC	2011	10.20	3.60	283.64	3.55	287.35
36	Morocco	MAR	NRC	2011	9.00	5.47	164.67	5.46	164.69
37	Namibia	NAM	NRC	2004	5.00	6.54	76.40	6.74	74.23
38	Nepal	NPL	NRC	2011	4.60	2.00	230.38	1.99	231.21
39	Nicaragua	NIC	NRC	2011	7.90	4.26	185.33	4.26	185.40
40	Niger	NER	NRC	2007	2.60	1.66	157.01	1.62	160.77
41	Nigeria	NGA	RDC	2008	0.20	2.52	7.93	2.50	7.99
42	Paraguay	PRY	NRC	2011	6.80	4.84	140.59	4.87	139.73
43	Peru	PER	RDC	2011	6.70	6.07	110.43	6.05	110.68
44	Philippines	PHL	NRC	2011	1.90	4.42	42.95	4.32	43.99
45	Rwanda	RWA	NRC	2011	4.10	2.10	194.95	2.09	196.09
46	Senegal	SEN	NRC	2011	7.80	3.47	225.00	3.31	235.82
47	Sri Lanka	LKA	NRC	2010	3.90	4.54	85.84	4.51	86.43
48	St. Lucia	LCA	NRC	2011	3.60	9.36	38.47	9.22	39.06
49	St. Vincent and the Grenadines	VCT	NRC	2011	7.10	8.21	86.47	8.16	86.97
50	Thailand	THA	RDC	2011	4.20	7.35	57.12	7.27	57.75
51	Togo	TGO	NRC	2011	8.20	2.40	341.96	2.34	350.35
52	Tunisia	TUN	NRC	2010	6.60	7.19	91.86	7.13	92.57
53	Turkey	TUR	NRC	2011	6.10	8.77	69.59	9.13	66.85
54	Uganda	UGA	NRC	2010	3.80	2.17	175.42	2.10	180.79
55	Venezuela, RB	VEN	RDC	2005	6.40	6.08	105.23	6.05	105.74
56	Vietnam	VNM	RDC	2004	5.80	3.23	179.36	3.16	183.50

Source: GFS (International Monetary Fund); WDI (World Bank) and authors' calculations.

TABLE 19 – Value-added potentials and efforts predicted by the truncated normal and the half models of Battese and Coelli (1992)

	Country	Code	Category	Year	VAT revenues to GDP	TN	T_effort(TN)	HN	T_effort(HN)
1	Albania	ALB	NCR	2011	9.10	16.83	54.08	16.38	55.56
2	Algeria	DZA	RDC	2011	3.50	12.11	28.89	11.75	29.79
3	Bangladesh	BGD	NCR	2011	3.70	8.86	41.75	8.69	42.58
4	Benin	BEN	NCR	2011	7.00	8.14	86.01	8.00	87.49
5	Bolivia	BOL	RDC	2007	7.10	9.49	74.80	9.28	76.52
6	Botswana	BWA	RDC	2011	4.50	26.62	16.90	25.80	17.44
7	Brazil	BRA	NCR	2011	7.90	21.98	35.94	21.18	37.30
8	Burkina Faso	BFA	NCR	2011	6.20	7.22	85.93	7.10	87.30
9	Burundi	BDI	NCR	1999	2.80	3.49	80.21	3.45	81.10
10	Cambodia	KHM	NCR	2010	3.70	9.52	38.88	9.44	39.18
11	Cameroon	CMR	RDC	1999	3.10	9.24	33.56	9.02	34.35
12	Cape Verde	CPV	NCR	2007	8.80	18.40	47.83	17.97	48.98
13	Central African Republic	CAF	NCR	2009	2.50	5.29	47.24	5.21	48.01
14	China	CHN	NCR	2010	5.90	12.67	46.56	12.33	47.86
15	Colombia	COL	NCR	2011	5.20	16.54	31.45	15.98	32.54
16	Congo, Rep.	COG	RDC	2005	2.30	6.11	37.64	6.00	38.35
17	Dominica	DMA	NCR	2011	9.10	23.59	38.58	22.86	39.81
18	Dominican Republic	DOM	NCR	2010	4.30	19.67	21.86	19.06	22.56
19	Ethiopia	ETH	NCR	2011	1.90	4.23	44.90	4.16	45.65
20	Fiji	FJI	NCR	2004	8.60	20.89	41.18	20.35	42.25
21	Ghana	GHA	NCR	2011	4.70	7.81	60.21	7.68	61.19
22	Guatemala	GTM	NCR	2011	5.30	13.94	38.02	13.57	39.05

	Country	Code	Category	Year	VAT revenues to GDP	TN	T_effort(TN)	HN	T_effort(HN)
23	Honduras	HND	NCR	2011	5.80	14.44	40.17	14.19	40.86
24	Indonesia	IDN	RDC	2011	3.70	12.02	30.79	11.71	31.58
25	Iran, Islamic Rep.	IRN	RDC	2009	0.50	26.55	1.88	25.83	1.94
26	Jamaica	JAM	NCR	2007	7.50	22.62	33.15	21.97	34.13
27	Kenya	KEN	NCR	2010	5.60	8.58	65.29	8.44	66.35
28	Lebanon	LBN	NCR	2009	4.90	24.52	19.99	23.75	20.64
29	Lesotho	LSO	NCR	2008	7.40	13.92	53.18	13.84	53.48
30	Madagascar	MDG	NCR	2008	2.20	7.21	30.51	7.12	30.89
31	Mali	MLI	NCR	2010	5.50	6.00	91.65	5.94	92.61
32	Mauritius	MUS	NCR	2011	7.00	33.73	20.76	32.83	21.32
33	Mexico	MEX	RDC	2011	3.80	23.93	15.88	23.01	16.51
34	Moldova	MDA	NCR	2011	12.70	13.25	95.86	13.20	96.20
35	Mongolia	MNG	RDC	2011	10.20	14.90	68.44	14.66	69.57
36	Morocco	MAR	NCR	2011	9.00	18.10	49.73	17.65	51.00
37	Namibia	NAM	NCR	2004	5.00	20.58	24.30	20.03	24.96
38	Nepal	NPL	NCR	2011	4.60	6.51	70.64	6.41	71.82
39	Nicaragua	NIC	NCR	2011	7.90	12.86	61.42	12.60	62.70
40	Niger	NER	NCR	2007	2.60	6.04	43.06	5.96	43.64
41	Nigeria	NGA	RDC	2008	0.20	5.83	3.43	5.72	3.50

	Country	Code	Category	Year	VAT revenues to GDP	TN	T_effort(TN)	HN	T_effort(HN)
42	Paraguay	PRY	NCR	2011	6.80	15.07	45.12	14.77	46.03
43	Peru	PER	RDC	2011	6.70	16.75	40.01	16.23	41.27
44	Philippines	PHL	NCR	2011	1.90	11.79	16.11	11.54	16.46
45	Rwanda	RWA	NCR	2011	4.10	5.75	71.30	5.65	72.53
46	Senegal	SEN	NCR	2011	7.80	10.15	76.82	9.95	78.37
47	Sri Lanka	LKA	NCR	2010	3.90	10.13	38.51	9.90	39.38
48	St. Lucia	LCA	NCR	2011	3.60	19.55	18.41	18.97	18.97
49	St. Vincent and the Grenadines	VCT	NCR	2011	7.10	46.22	15.36	44.82	15.84
50	Thailand	THA	RDC	2011	4.20	18.68	22.48	18.25	23.02
51	Togo	TGO	NCR	2011	8.20	8.69	94.36	8.66	94.74
52	Tunisia	TUN	NCR	2010	6.60	19.25	34.29	18.74	35.22
53	Turkey	TUR	NCR	2011	6.10	23.07	26.44	22.24	27.43
54	Uganda	UGA	NCR	2011	4.00	5.85	68.38	5.76	69.41
55	Venezuela, RB	VEN	RDC	2005	6.40	18.80	34.03	18.14	35.28
56	Vietnam	VNM	RDC	2004	5.80	10.22	56.72	10.10	57.45

Source: GFS (International Monetary Fund); WDI (World Bank) and authors' calculations.

TABLE 20 – LICs' value-added tax potentials and efforts predicted by the model of Kumbhakar, Lien and Hardaker (2014)

	Country	Code	Category	Year	VAT revenues to GDP	KH14	Overall VAT_effort	Time- varying VAT_effort	Persistent VAT_effort
1	Bangladesh	BGD	NRC	2011	3.70	6.66	55.52	89.80	61.82
2	Benin	BEN	NRC	2011	7.00	9.69	72.28	87.90	82.23
3	Burkina Faso	BFA	NRC	2011	6.20	8.25	75.12	91.18	82.39
4	Cambodia	KHM	NRC	2010	3.70	6.72	55.08	91.80	60.00
5	Central African Republic	CAF	NRC	2009	2.50	4.07	61.49	90.90	67.65
6	Ethiopia	ETH	NRC	2011	1.90	3.35	56.66	87.72	64.60
7	Kenya	KEN	NRC	2010	5.60	8.06	69.52	91.20	76.23
8	Madagascar	MDG	NRC	2008	2.20	4.92	44.71	92.55	48.31
9	Mali	MLI	NRC	2010	5.50	7.50	73.35	87.84	83.51
10	Nepal	NPL	NRC	2011	4.60	6.43	71.49	91.04	78.53
11	Niger	NER	NRC	2007	2.60	4.36	59.61	93.55	63.72
12	Rwanda	RWA	NRC	2011	4.10	6.11	67.05	85.06	78.83
13	Togo	TGO	NRC	2011	8.20	10.52	77.98	92.62	84.19
14	Uganda	UGA	NRC	2011	4.00	6.09	65.65	85.38	76.90

Source: GFS (International Monetary Fund); WDI (World Bank) and authors' calculations.

TABLE 21 – LMICs' value-added tax potentials and efforts predicted by the model of Kumbhakar, Lien and Hardaker (2014)

	Country	Code	Category	Year	VAT revenues to GDP	KH14	Overall VAT_effort	Time- varying VAT_effort	Persistent VAT_effort
1	Bolivia	BOL	RDC	2007	7.10	10.21	69.52	89.24	77.90
2	Cameroon	CMR	RDC	1999	3.10	6.39	48.55	90.05	53.91
3	Cape Verde	CPV	NRC	2007	8.80	14.42	61.02	89.76	67.98
4	Congo, Rep.	COG	RDC	2005	2.30	6.73	34.15	69.78	48.94
5	Ghana	GHA	NRC	2011	4.70	7.23	65.01	87.61	74.20
6	Guatemala	GTM	NRC	2011	5.30	10.67	49.65	86.36	57.49
7	Honduras	HND	NRC	2011	5.80	10.93	53.04	88.60	59.87
8	Indonesia	IDN	RDC	2011	3.70	8.43	43.88	88.63	49.51
9	Lesotho	LSO	NRC	2008	7.40	11.81	62.67	90.68	69.11
10	Moldova	MDA	NRC	2011	12.70	17.43	72.88	85.93	84.82
11	Mongolia	MNG	RDC	2011	10.20	14.09	72.39	95.91	75.48
12	Morocco	MAR	NRC	2011	9.00	14.31	62.90	91.87	68.47
13	Nicaragua	NIC	NRC	2011	7.90	11.82	66.84	89.56	74.63
14	Nigeria	NGA	RDC	2008	0.20	3.23	6.18	82.09	7.53
15	Paraguay	PRY	NRC	2011	6.80	11.56	58.80	90.61	64.89
16	Philippines	PHL	NRC	2011	1.90	7.64	24.86	87.20	28.51
17	Senegal	SEN	NRC	2011	7.80	11.02	70.78	88.85	79.65
18	Sri Lanka	LKA	NRC	2010	3.90	8.57	45.51	77.49	58.73
19	Vietnam	VNM	RDC	2004	5.80	8.82	65.75	90.99	72.26

Source: GFS (International Monetary Fund); WDI (World Bank) and authors' calculations.

TABLE 22 – UMICs' value-added tax potentials and efforts predicted by the model of Kumbhakar, Lien and Hardaker (2014)

	Country	Code	Category	Year	VAT revenues to GDP	KH14	Overall VAT_effort	Time- varying VAT_effort	Persistent VAT_effort
1	Albania	ALB	NRC	2011	9.10	14.94	60.90	85.13	71.54
2	Algeria	DZA	RDC	2011	3.50	9.67	36.18	84.77	42.68
3	Botswana	BWA	RDC	2011	4.50	17.08	26.35	91.45	28.81
4	Brazil	BRA	NRC	2011	7.90	15.82	49.94	91.29	54.70
5	China	CHN	NRC	2010	5.90	11.25	52.44	79.09	66.31
6	Colombia	COL	NRC	2011	5.20	12.02	43.27	87.40	49.51
7	Dominica	DMA	NRC	2011	9.10	17.37	52.39	87.77	59.69
8	Dominican Republic	DOM	NRC	2010	4.30	13.05	32.95	87.30	37.74
9	Fiji	FJI	NRC	2005	8.20	15.27	53.72	86.16	62.35
10	Iran	IRN	RDC	2009	0.50	11.08	4.51	96.71	4.67
11	Jamaica	JAM	NRC	2007	7.50	16.01	46.85	88.10	53.19
12	Lebanon	LBN	NRC	2009	4.90	16.25	30.15	86.63	34.80
13	Mauritius	MUS	NRC	2010	7.10	22.50	31.56	95.02	33.21
14	Mexico	MEX	RDC	2011	3.80	16.44	23.12	90.62	25.51
15	Namibia	NAM	NRC	2004	5.00	13.04	38.34	90.44	42.39
16	Peru	PER	RDC	2011	6.70	12.96	51.69	88.95	58.11
17	St Vincent	VCT	NRC	2011	7.10	25.73	27.60	97.22	28.39
18	Thailand	THA	RDC	2011	4.20	13.33	31.50	87.54	35.99
19	Tunisia	TUN	NRC	2010	6.60	14.19	46.50	86.44	53.80
20	Turkey	TUR	NRC	2011	6.10	16.53	36.90	88.02	41.92
21	Venezuela	VEN	RDC	2005	6.40	13.66	46.86	92.62	50.59

Source: GFS (International Monetary Fund); WDI (World Bank) and authors' calculations.

TABLE 23 – LICs' value-added tax potentials and efforts predicted by the model of Kumbhakar, Lien and Hardaker (2014) by the top 10 percentile and median estimations

	Country	Code	Category	Year	VAT revenues to GDP	KH_TP	Overall T_effort (KH_TP)	Time-varying T_effort (KH_TP)	Persistent T_effort (KH_TP)	KH_Med	Overall T_effort (KH_Med)	Time-varying T_effort (KH_Med)	Persistent T_effort (KH_Med)
1	Bangladesh	BGD	NRC	2011	3.70	14.89	24.86	85.06	28.81	6.98	53.04	88.60	59.87
2	Benin	BEN	NRC	2011	7.00	28.16	24.86	85.06	28.81	13.20	53.04	88.60	59.87
3	Burkina Faso	BFA	NRC	2011	6.20	24.94	24.86	85.06	28.81	11.69	53.04	88.60	59.87
4	Cambodia	KHM	NRC	2010	3.70	14.84	24.93	80.08	28.81	7.06	52.44	87.60	59.87
5	Central African Republic	CAF	NRC	2009	2.50	9.17	27.26	82.09	28.81	4.83	51.76	86.94	59.69
6	Ethiopia	ETH	NRC	2011	1.90	7.64	24.86	85.06	28.81	3.58	53.04	88.60	59.87
7	Kenya	KEN	NRC	2010	5.60	22.46	24.93	80.08	28.81	10.68	52.44	87.60	59.87
8	Madagascar	MDG	NRC	2008	2.20	8.89	24.76	81.63	28.51	4.23	51.96	89.19	58.73
9	Mali	MLI	NRC	2010	5.50	22.06	24.93	80.08	28.81	10.49	52.44	87.60	59.87
10	Nepal	NPL	NRC	2011	4.60	18.51	24.86	85.06	28.81	8.67	53.04	88.60	59.87
11	Niger	NER	NRC	2007	2.60	10.07	25.82	81.80	28.81	5.00	51.96	89.13	59.21
12	Rwanda	RWA	NRC	2011	4.10	16.49	24.86	85.06	28.81	7.73	53.04	88.60	59.87
13	Togo	TGO	NRC	2011	8.20	32.99	24.86	85.06	28.81	15.46	53.04	88.60	59.87
14	Uganda	UGA	NRC	2011	4.00	16.09	24.86	85.06	28.81	7.54	53.04	88.60	59.87

Source: GFS (International Monetary Fund); WDI (World Bank) and authors' calculations.

TABLE 24 – LMICs' value-added tax potentials and efforts predicted by the model of Kumbhakar, Lien and Hardaker (2014) by the top 10 percentile and median estimations

	Country	Code	Category	Year	VAT revenues to GDP	KH_TP	Overall T_effort (KH_TP)	Time-varying T_effort (KH_TP)	Persistent T_effort (KH_TP)	KH_Med	Overall T_effort (KH_Med)	Time-varying T_effort (KH_Med)	Persistent T_effort (KH_Med)
1	Bolivia	BOL	RDC	2007	7.10	27.50	25.82	81.80	28.81	13.66	51.96	89.13	59.21
2	Cameroon	CMR	RDC	1999	3.10	10.84	28.59	79.91	32.17	6.75	45.93	85.77	54.31
3	Cape Verde	CPV	NRC	2007	8.80	34.09	25.82	81.80	28.81	16.94	51.96	89.13	59.21
4	CongoRep	COG	RDC	2005	2.30	9.01	25.53	78.33	32.17	4.59	50.07	86.39	58.73
5	Ghana	GHA	NRC	2011	4.70	18.91	24.86	85.06	28.81	8.86	53.04	88.60	59.87
6	Guatemala	GTM	NRC	2011	5.30	21.32	24.86	85.06	28.81	9.99	53.04	88.60	59.87
7	Honduras	HND	NRC	2011	5.80	23.33	24.86	85.06	28.81	10.93	53.04	88.60	59.87
8	Indonesia	IDN	RDC	2011	3.70	14.89	24.86	85.06	28.81	6.98	53.04	88.60	59.87
9	Lesotho	LSO	NRC	2008	7.40	29.89	24.76	81.63	28.51	14.24	51.96	89.19	58.73
10	Moldova	MDA	NRC	2011	12.70	51.09	24.86	85.06	28.81	23.94	53.04	88.60	59.87
11	Mongolia	MNG	RDC	2011	10.20	41.04	24.86	85.06	28.81	19.23	53.04	88.60	59.87
12	Morocco	MAR	NRC	2011	9.00	36.21	24.86	85.06	28.81	16.97	53.04	88.60	59.87
13	Nicaragua	NIC	NRC	2011	7.90	31.78	24.86	85.06	28.81	14.89	53.04	88.60	59.87
14	Nigeria	NGA	RDC	2008	0.20	0.81	24.76	81.63	28.51	0.38	51.96	89.19	58.73
15	Paraguay	PRY	NRC	2011	6.80	27.36	24.86	85.06	28.81	12.82	53.04	88.60	59.87
16	Philippines	PHL	NRC	2011	1.90	7.64	24.86	85.06	28.81	3.58	53.04	88.60	59.87
17	Senegal	SEN	NRC	2011	7.80	31.38	24.86	85.06	28.81	14.71	53.04	88.60	59.87
18	Sri Lanka	LKA	NRC	2010	3.90	15.64	24.93	80.08	28.81	7.44	52.44	87.60	59.87
19	Vietnam	VNM	RDC	2004	5.80	19.53	29.70	79.71	33.21	11.37	50.99	87.02	58.73

Source: GFS (International Monetary Fund); WDI (World Bank) and authors' calculations.

TABLE 25 – UMICs' value-added tax potentials and efforts predicted by the model of Kumbhakar *et al.* (2014) by the top 10 percentile and median estimations

	Country	Code	Category	Year	VAT revenues to GDP	KH_TP	Overall T_effort (KH_TP)	Time-varying T_effort (KH_TP)	Persistent T_effort (KH_TP)	KH_Med	Overall T_effort (KH_Med)	Time-varying T_effort (KH_Med)	Persistent T_effort (KH_Med)
1	Albania	ALB	NRC	2011	9.10	36.61	24.86	85.06	28.81	17.16	53.04	88.60	59.87
2	Algeria	DZA	RDC	2011	3.50	14.08	24.86	85.06	28.81	6.60	53.04	88.60	59.87
3	Botswana	BWA	RDC	2011	4.50	18.10	24.86	85.06	28.81	8.48	53.04	88.60	59.87
4	Brazil	BRA	NRC	2011	7.90	31.78	24.86	85.06	28.81	14.89	53.04	88.60	59.87
5	China	CHN	NRC	2010	5.90	23.67	24.93	80.08	28.81	11.25	52.44	87.60	59.87
6	Colombia	COL	NRC	2011	5.20	20.92	24.86	85.06	28.81	9.80	53.04	88.60	59.87
7	Dominica	DMA	NRC	2011	9.10	36.61	24.86	85.06	28.81	17.16	53.04	88.60	59.87
8	Dominican Republic	DOM	NRC	2010	4.30	17.25	24.93	80.08	28.81	8.20	52.44	87.60	59.87
9	Fiji	FJI	NRC	2005	8.20	32.12	25.53	78.33	32.17	16.38	50.07	86.39	58.73
10	Iran	IRN	RDC	2009	0.50	1.83	27.26	82.09	28.81	0.97	51.76	86.94	59.69
11	Jamaica	JAM	NRC	2007	7.50	29.05	25.82	81.80	28.81	14.43	51.96	89.13	59.21
12	Lebanon	LBN	NRC	2009	4.90	17.98	27.26	82.09	28.81	9.47	51.76	86.94	59.69
13	Mauritius	MUS	NRC	2010	7.10	28.48	24.93	80.08	28.81	13.54	52.44	87.60	59.87
14	Mexico	MEX	RDC	2011	3.80	15.29	24.86	85.06	28.81	7.16	53.04	88.60	59.87
15	Namibia	NAM	NRC	2004	5.00	16.83	29.70	79.71	33.21	9.81	50.99	87.02	58.73
16	Peru	PER	RDC	2011	6.70	26.95	24.86	85.06	28.81	12.63	53.04	88.60	59.87
17	StVincent	VCT	NRC	2011	7.10	28.56	24.86	85.06	28.81	13.39	53.04	88.60	59.87
18	Thailand	THA	RDC	2011	4.20	16.90	24.86	85.06	28.81	7.92	53.04	88.60	59.87
19	Tunisia	TUN	NRC	2010	6.60	26.47	24.93	80.08	28.81	12.59	52.44	87.60	59.87
20	Turkey	TUR	NRC	2011	6.10	24.54	24.86	85.06	28.81	11.50	53.04	88.60	59.87
21	Venezuela	VEN	RDC	2005	6.40	25.07	25.53	78.33	32.17	12.78	50.07	86.39	58.73

Source: GFS (International Monetary Fund); WDI (World Bank) and authors' calculations.